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ERRATA

No. 2, February 1942, p. 81, in the table pertaining to Magnetic Notes: Under Quiet days, figure 18 has been omitted, and under Moderate days *for* 2 *read* 17.

No. 3, March 1942, p. 107, Fig. 3: *read* "hn" instead of "gn".

No. 6, June 1942, p. 242, in the legend below Fig. 1, *read* "right" for the word "left" within the brackets. In the right half of the page, line 3, the word "right" should be read as "left".

No. 8, August 1942, page 330, Note entitled "Arc Lines of Copper in Flame Spectra": *Add* the following before the present opening sentence:—

"In the course of an investigation which is in progress and a preliminary report about which has already been published on the study of the flame spectra of copper salts, we have found a few interesting points regarding the excitation of certain atomic lines of copper which it is our purpose to report in this note."

In line 9, *for* $3d^94s$ (3D) *read* $3d^94s$ (^{3}D).
Add the following after the last sentence:—

"Full details regarding these and other features of the flame spectra will be published elsewhere; I also feel it a pleasure to thank Prof. Dr. R. K. Asundi for valuable discussion."

Page 334, Table I*b*, under Moisture and Protein, the figures for Sode II and Golim should be as follows:—

74·80 19·41
75·30 19·60

and not

19·41 2·08
19·6 2·86.

No. 10, October 1942, page 393, first column, line 10, *for* "fall" *read* "rise".
Page 394, para 2, lines 13 and 14, *for* "2·4-4·0 mg.", *read* "0·24-0·40 mg."

No. 11, November 1942, page 423, para 3, line 8, *for* "useful References" *read* "Useful References". Para 5, line 14, *for* "Universal" *read* "universal". Para 6, line 4, *for* "semisolid", *read* "semi-solid". Para 8, line 2, *for* "Air Raids" *read* "air raids".
Page 424, para 1, line 3, *for* "into recipient", *read* "into a recipient"; line 8, *for* "nitrate", *read* "chloride". Para 9 *for* "*fluid must*", *read* "fluid must" (no italics). In the table, column 2, *for* "(= nothing small letter)", *read* "(= nothing, small letter)".
Page 425, in the List of Useful References, items (13) and (14), *delete* "(in press)", and *add* "1941".
Page 430, second column, line 1, *for* "K = (4·68 ± 5)", *read* "K = 4·68 ± 0·5".
Page 438, second column, regarding magnification of the photomicrographs, *for* "× 60", *read* "× 60, reduced to ½".

322-43—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science", Bangalore.

CURRENT SCIENCE

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SCIENCE AND THE WORLD OF TODAY

ANOTHER article in this issue of *Current Science* deals with that part of Mr. D. N. Wadia's presidential address to the 29th Indian Science Congress (Baroda) which reviews certain aspects of the geological structure of India. This note is intended to consider some general remarks made by him on the now much-discussed subject of the relation between science and the world of today. He enters a protest against the suspicion and uneasiness expressed of late by some no doubt well-meaning people about the growing power of science. In this timely protest, Mr. Wadia has voiced the feeling not only of scientists in general, but of all men of cultivated intelligence and just sensibility to benefits received. All alike will share his hope that "science will, without doubt, re-build the damaged world on better foundations and reintegrate the stricken people to a new and more secure life". To cherish such a hope is, however, to admit the social responsibility of the scientist; and if that social responsibility is admitted by the scientist, he cannot consistently repudiate the charge that till now science has gone on in forgetfulness of that responsibility; for if science had remembered that responsibility and taken thought as to ways of implementing it, we should not have had to witness the present wreckage of civilization. The difference between the present war and the wars of antiquity, in magnitude and in incidence of destructiveness, is the difference made by the progress of science. If science may claim, as Mr. Wadia claims on its behalf, credit for having conquered "many plagues and diseases" and "probing truths about creation," she must just as well be

prepared to take the blame that belongs to the discovery of fire-bombers and poison gas. Among her children are both angels and their opposites.

It is no use trying to plead that the scientist is innocent and lay the blame exclusively at the doors of the politician and the manufacturer. These no doubt have their share in this organization of disaster. But they have equally a share in science's record of regenerative service to mankind. What can be legitimately claimed for the scientist is that he has had no share in the profits reaped by the manufacturer or the applause elicited by the war-minister, and that he had no personal interest to promote. This plea, however, can be of no avail to him against the charge of negligence and want of wakefulness. Nobody would think of accusing the scientist of homicidal designs; but at the same time nobody could help thinking that, in not taking heed about the dangerous potentialities of his handiwork, he betrayed a singular lack of appreciation of his responsibility as a social being. In purest innocence, but equally in surest thoughtlessness, he helped to upset humanity's apple-cart. The lesson for him today is that he should beware of jingo-politicians and greedy merchants. Mr. Wadia is on the hopeful track when he speaks of "the democracy of science and altruistic knowledge" and suggests an international directorate of scientists as a means of preventing the abuse of science.

But it is not clear that in his plan of an international directorate, there will be a place for politicians. He indeed appears to think that "chancellors, diplomats and politicians" have had a long enough chance and must now be put aside. This is rather an unscientific judgement for a scientist to pass on fellow-labourers of another category. The root cause of war is in the organization of unsatisfied human hungers and the counter-organization of fears and greeds which it provokes. The righteous politician endeavours to regulate the hungers, and the unrighteous one to excite and extend them. But neither creates the hunger, nor can either abolish it altogether; nor can the man of science either. The politician in any case has to reckon with it; and he has the duty of making a "science" of his job too to the extent possible. Our trouble of today is the outcome of the long-existing aloofness between the so-called natural sciences on the one side and the social sciences on the other; between the exact knowledge of the external world on the one side and the hints and guesses of man's internal world on the other side; between physics and chemistry and biology and the like on the one side and psychology and religion and economics and politics on the other side. Sir V. T. Krishnamachari (Dewan of Baroda), as was only to be expected of him, spoke like one who has observed life and pondered over its problems from many points of view when, in his speech welcoming the Science Congress, he said:—

> The evil thus calls for not less of science but more of science—science in the broadest sense of the word, embracing the social sciences, those dealing with human relations—and also philosophy—all working with a common aim and a sense of unity and viewing life as a whole. Only thus can civilization be re-shaped so as to enable human personality to reach the fullest development of which it is capable.

What can save mankind is the cultivation of a unified and synoptic view of life,—a philosophy of world management in which

the sciences and the arts,—the achievements of the laboratory and the appeals of the music hall and the theatre, the findings of statistics and the messages of literature,—are all brought into correlation in the service of a large and upward-looking humanism. It is for such a synthesis that the world is waiting. A corollary to this belief is that science should refuse to be controlled by narrownesses of geography and race miscalled patriotism and nationalism. Science should commit its achievements to the care and management of a truly international agency which can be trusted to function with every conscientious care for the welfare of the whole of mankind and in no partiality or favouritism for any section or division of it. Patents and monopolies must be destroyed; and all that is of value and significance should become available to the public of the entire international world. This is a condition of minimising the evil possibilities inherent in the possession of lethal secrets.

In speaking of the philosophical achievement of science, Mr. Wadia has used language which does not quite accord with the attitude of modesty proper to science. He says that "science is near making an approach to Absolute Truth". How near?—one may ask; for, measurement implies precise knowledge of the two ends of the road. Has any one a fore-knowledge of what absolute truth is and how the distance between that truth and ourselves is to be measured? Many are the pilgrims that fancy themselves to be on the road to the shrine of absolute truth. Metaphysics, poetry, art—these too have been endeavouring to capture a vision of the reality behind the phenomena of the universe. Here, as in the effort to secure world-peace, there is no warrant for the hope that the prize is for the soloist, whether he be scientist or poet or man of religion. True vision is to be hoped for only from the focussing of rays from all quarters from which light may shine. The several rays will serve both to correct and to supplement one another.

Indeed, is science unitary? Is it not still in a state of flux? Are its many branches speaking with one voice? With the progress of research and the increase of the armies of researchers, ramifications of science have become so many, and specialism has gone so far afield along every line, that anything like a unified and consistent message of science as a whole as to the principle of Nature and the meaning of life seems at the present stage to be impossible to arrive at. While some of the many mouths of science are speaking more or less clearly and others are just making inarticulate sounds, there are others that have not become even vocal yet. Until science has come to speak in one final voice, it is best she should have the candour to say that her final answer is not ready yet to the ultimate questions of life and reality. Perhaps it is inevitable that science should for ever remain as various in her speech as Nature appears to be in her plans,—as various in its findings, as tentative, as wanting in definitiveness on questions pertaining to that which (if it exists) transcends all the shapes and forms and forces of Nature. If this position is accepted by the scientist, it would be a contribution of some real value to the needed philosophy of life. Elimination of exaggeration is also a step taken towards Truth.

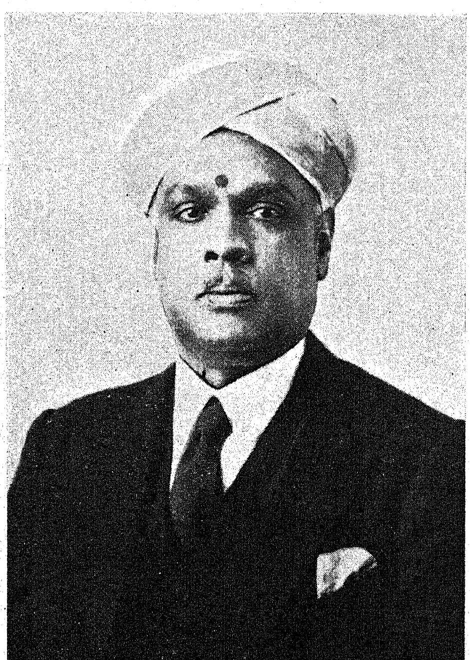
D. V. G.

THE INDIAN JOURNAL OF GENETICS AND PLANT BREEDING

THIS is a welcome addition to the ranks of Indian scientific journals. It is the official publication of the Indian Society of Genetics and Plant Breeding. New scientific societies intended to follow up different branches of science are "a natural phenomenon and often connote vitality and survival value". The Indian continent is rich in crops and domesticated animals and has many centres for their breeding. The Journal should therefore have plenty of data and experience to record. It is hoped that the linking of Genetics to Plant Breeding will result in the creative development of better crops and animals, through superior germ plasm. We wish this new Journal a career of prosperity and usefulness.

PROF. C. R. NARAYAN RAO, M.A.

FRIENDS of *Current Science* will learn with regret that PROF. C. R. NARAYAN RAO, who has been the Chief Editor since



its inception in July 1932, has retired from the Editorial Board, as from the 11th of this month. The world will never know the great many services he has rendered to the Journal and the very many critical phases of development through which the Journal has been successfully piloted by him. After his retirement from the Mysore University Service in 1937, he continued to devote himself to the work of the Journal and the greatest and the most enduring contribution which Prof. Narayan Rao has made to the advancement of *Current Science* is the organization of a band of young and devoted enthusiasts who, out of pure love of the cause, have given freely of their time and labour for the service of the Journal under his inspiring guidance.

In December 1938, he undertook an all-India tour at great personal sacrifice and visited many of the university centres and the capitals of Indian States in Western and Northern India as the envoy of *Current Science* pleading for increased financial support; the response has been both spontaneous and generous. Prof. Narayan Rao may well feel proud of the high prestige which the Journal now commands in the field of international science. We have every hope that he will continue to evince the same keen interest in the progress of the Journal. All friends of *Current Science* will join with us in wishing him long life and unalloyed happiness in his retirement.

SIR T. S. VENKATRAMAN, Kt., C.I.E., D.Sc., I.A.S.

We wish to extend our hearty felicitations to Sir S. Venkatraman of Tiruvadi, C.I.E., D.SC., I.A.S., on the occasion of the

conferment of the Order of Knight-Bachelor by His Majesty the King-Emperor, in the New Year Honours' List. This distinction is a belated recognition of his invaluable and brilliant scientific contributions to the development of the sugarcane production covering a period of more than 30 years. The Sugarcane Breeding Station at Coimbatore will ever remain a monument to his devoted labours and constitutes the very foundation on which the present prosperity of the Indian sugar industry rests. The breeding work carried out by Sir Venkatraman—aided by ample tariff protection—has been responsible for converting India from an importer of white sugar (1 million tons) to a position where the future of the Indian industry is in urgent need of securing export markets. It has been computed that the work has resulted in a conservation of about 15 crores of rupees in the country besides the obvious advantages which a prosperous industry necessarily brings to the cultivator and the manufacturer. These were denied to this impoverished country for at least half a century. We wish Sir Venkatraman many many years of greater achievement in his scientific field and many a higher distinction to crown his labours.

DEWAN BAHADUR DR. A. LAKSHMANASWAMI MUDALIAR

It is with great pleasure that we announce that Dr. A. Lakshmanaswami Mudaliar, Principal, Madras Medical College, has received the distinction of the Fellowship of the American College of Gynæcological Surgeons. He is the first Indian to receive this honour. Dr. Mudaliar enjoys the reputation of being one of the foremost Obstetricians and Gynæcologists of the day. In 1930 he was elected a Foundation Fellow of the British College of Obstetricians and Gynæcologists in England. His contributions to the development of this vital part of medical science, are well known and widely recognised.

Dr. Mudaliar, as member of the Syndicate of the Madras University, as the member of the Medical Council of India, as member of the Indian Research Fund Association and as the University representative on the Council of the Indian Institute of Science, has advanced the cause of higher medical education and medical research in this country. *Current Science* is fortunate in having Dr. Mudaliar as one of its staunchest supporters. The Government of India have decorated him with the title of Dewan Bahadur in recognition of his services.

We wish to offer Dr. Mudaliar our hearty felicitations on the distinctions conferred upon him.

THE ORIGIN OF THE SOLAR SYSTEM

BY
V. V. NARLIKAR
(*Benares Hindu University*)

THE problem of the origin of the solar system has defied all attempts at solution and it has been, for over a century, an outstanding challenge to mathematicians. Once it was considered to be essentially a hydrodynamical problem and it inspired a series of researches by Tchebycheff, Liapounoff, (Sir George) Darwin, Poincare, Jeans and others. With the accumulation of data the centre of enquiry shifted to the dynamical features of the system. And now, with our knowledge of the internal constitution of stars, we find the problem much more complicated than what it was originally understood to be.

WHAT DO WE MEAN BY THE SOLAR SYSTEM?

The solar system consists of the day star, that is, the sun, nine major planets with their twenty-eight satellites, over fifteen hundred planetoids and thousands of comets, not to mention the countless meteors and meteorites that cross the earth's way in the skies. The satellites move about their respective planets and the planets, planetoids and comets about the sun. The sun itself moves with the velocity, 300 km. sec.$^{-1}$, relative to the centre of the galaxy.[16] But we are not concerned here with the solar motion as the system is practically isolated from the rest of the universe. Light does not take more than a few hours to go from one end of the solar system to another while the journey from the nearest star to the sun is a matter of no less than four years. The most striking feature of the isolated system is that while most of the matter is concentrated in the sun, most of the motion is associated with the rest. The solar mass is 744 times the mass of the rest although the sun's share of the total angular momentum of the system is hardly three per cent. It is also noteworthy that the central body, the sun, is self-luminous while the planets and satellites which represent practically all the matter and angular momentum of the rest, are opaque bodies reflecting the solar light. By the solar system we mean therefore a luminous mass, a star, surrounded by dark bodies, much smaller in weight, moving fast enough to make the distribution of matter and motion extremely uneven as stated above.

IS THERE IN THE WHOLE UNIVERSE ONLY ONE SYSTEM LIKE THE SOLAR SYSTEM?

The tower of observation rises high above the mansion of theory. Whenever, therefore, observation gives one answer to a scientific question and theory another, the former is regarded as right and the latter indisputably wrong. Suppose that the nearest star,[14] Wolf 424 (?), possesses a planetary system like ours. Can the planets at that distance from us be visible at all on the earth? Russell[15] replies in the negative adding that they won't be visible through the most powerful telescope that we have or that we can construct. Observation cannot therefore provide a decisive answer to the question mooted above. Recourse is now had to theory and we stalk the question by enquiring how a system such as the solar system could originate in a primitive world of stars and nebulæ. If we trace the history of the solar system backward, along the lines of evolution, we may arrive, at a fairly distant epoch, at diverse sets of plausible circumstances in which case we will conclude that there are many such systems in the universe. If, however, the circumstances as demanded by the theory at that epoch are highly improbable, in the then state of the world, the solar system will be regarded a freak of nature.

The matter is not however so simple. As E. W. Brown[1] has shown it is not possible to trace the evolution backward beyond a hundred million years without applying the complicated relativistic correction. According to the theory of space and time to which we are committed by our knowledge of gravitational and world situations a small primeval universe of matter became unstable and broke up into stars and nebulæ some two thousand million years ago. Moreover, the geologist puts the age of the earth at several thousand million years on the evidence of uranium, thorium, helium

and lead in rocks. So we cannot ignore the relativistic correction in the treatment of the evolution of the system. It is required that on no account must theory outrun the limits of observation. If it is impossible to settle by observation whether there is only one solar system or more theory must give an equally ambiguous decision about the probability of the genesis of a planetary system in a world of stars and nebulæ. The failure of the theoretical investigation is, therefore, a foregone conclusion. In non-trivial mathematics we reach a substratum of propositions that cannot be demonstrated, which are couched in terms that cannot be defined. Similarly, an investigation of trivial mathematics rests on some assumption that cannot be justified, which relates to circumstances that are never fully understood. It has been seriously suggested by some that the stars, the nebulæ and the planetary systems (one or many that there are) must have all come into existence about the same time. This suggestion merely drives the required explanation further away into the unknown and the investigator who accepts it finds himself in a blind alley. An obvious implication of the suggestion is that the cosmic upheaval which was responsible for the genesis of millions of stars and nebulæ might have produced numerous solar systems also.

The theoretical worker cannot visualize the detailed processes in the world catastrophe leading to the creation of stars, nebulæ or the solar system. Under these circumstances it appears more probable that many systems possessing the two patent characteristics of the solar system were created. These are first thoughts; a closer scrutiny of the system reveals a number of regular features which deserve to be noted here.[6] (1) Most of the matter outside the sun in the system is shared by the major planets all of which move practically in the same plane. (2) The solar axis of spin is nearly perpendicular to this plane. (3) Most planets and a majority of the satellites spin in the same sense as the sun, there being only nine or ten satellites with retrograde motion.[2] (4) The satellite systems of Jupiter and Saturn are miniature models of the solar system, the nearer satellites moving in the neighbourhood of the equatorial plane of the central planet. (5) The orbits of most of the planets are nearly circular. (6) The mean distances of the planets from the sun and of the satellites from the corresponding central planets follow a simple empirical law which is a generalization of Bode's law.[13] All these regularities are not just an aftergrowth achieved in the long period of evolution after the genesis of the system. The problem of the origin of the solar system is really to infer how these and other regular features came into being and developed. The hypothesis of a world catastrophe does not help us to solve the problem.

As we will presently see other theoretical lines of investigation are possible. Whatever answer they provide to the question under consideration will attain the status of a theoretical speculation only. This is due to our inability to settle the question by observation. In spite of this the theoretical study of the problem is vigorously pursued because, evidently, "the pursuit of truth is more precious to man than truth itself".

Those who reject the theory of a world catastrophe start with the assumption that the planets are the offspring of a star. Modern spectroscopic and geological research supports this assumption. The theories that are built upon this basis are not less objectionable than that of the world catastrophe. But they have one distinguishing characteristic which is that they make the birth of planets a very rare phenomenon. Thus neither theory nor observation can satisfactorily settle whether the solar system is a common or an uncommon feature of the universe.

Is the Sun the Parent Body?

Having decided to explore the possibility of the planets being born of a star one would examine whether the sun itself is not the parent body. Luyten,[7, 8, 9] who has considered the question very thoroughly believes even to-day, on account of the regular features of the solar system, that no extraneous disturbing agent was responsible for its origin. This probably means that according to him, the sun is the parent body. Babinet's calculations[3] of 1861, revised in later years by others, definitely show that a star having the mass and the angular momentum of the solar system and the density of the sun cannot break up through instability. The ruling conceptions about the internal constitution of stars and their energy generation do not warrant that a G-type dwarf like the sun was ever a variable star or a nova

or thermodynamically unstable in any way, at any time, in the past. Even if we concede the possibility that the sun was unstable once it will still require proof that its fission has led to the planetary system with all its features. The simpler problem about the origin of binary stars has not yet been solved in this way and experts are of the opinion that fission may have nothing to do with it. Even in the matter of the earth-moon system the idea of fission was finally abandoned, about twelve years back. The prevalent view is that mere mechanical or thermodynamical instability in the sun, in the absence of an outer influence, could not be a sufficiently effective agent for the genesis of the planets. Apart from that, even if a break-up occurred, as suggested, it is difficult to see how planets with their shapes, sizes, momenta and orbits were formed in this manner.

Attempts have been made to explain the formation of planets out of the solar material under the gravitational influence of a visiting star. There is the American theory of Chamberlin and Moulton which has been ignored in Great Britain and there is the British theory of Jeans and Jeffreys which has been ignored in America. While the two theories differ in their descriptive contents, in all essential respects and in all crucial matters, both have many identical weaknesses and fail equally miserably. Granted that matter is pulled out of the sun under the attraction of the visiting star we cannot decide whether the encounter should be too close or fairly distant. For unless the encounter is sufficiently distant the planets formed out of the ribbon of matter stretching from the sun to the star cannot have the large angular momentum per ton that they have. On the contrary, it seems that unless the encounter is very close sufficient matter cannot impinge upon the condensing planets to give them the required spin about the axis. These conflicting demands of the theories have rendered them invalid although the formation of a ribbon is suggested by the order of sizes and masses of the planets and their numbers of satellites from Mercury to Pluto. There is an additional difficulty also regarding the condensation of the material in the ribbon into planets. At the high stellar temperatures, it is not at all clear, how the hydrogen of the ribbon failed to escape from the weak forces of gravitation and how the condensations were formed.[8,12] But then probably the very smallness of mass of the planets suggests that a good deal of the material escaped in the process of condensation. It is argued that hydrogen may have been reacquired later by accretion.

Thus it appeared that the formation of a ribbon was an essential stage in the genesis of the planets. It became also evident that a collision of the type envisaged by Jeans, Moulton or Jeffreys[4] was not responsible for the ribbon. So now arose the theory of Russell and Lyttleton[9] that the parent-body of the planets was some other star, out of which a ribbon was drawn by a very massive star in a near collision and that the sun, which happened to be in the neighbourhood, captured most of the material of the ribbon.

Lyttleton's Theory

Lyttleton has to consider the three-body situation of the gravitational problem. Following Jeffreys he admits explicitly that, as precise details could not be given, he has confined himself only to the orders of magnitudes. He uses the three integrals of energy, momentum and angular momentum and considers a redistribution of the quantities as a result of the encounter without violating the principles of conservation. It is nowhere proved that such a redistribution is actually permitted by the equations of motion. The circumstances[8] under which the redistribution as devised would actually occur are not known. It[11,12] is so arranged that the very massive star (of mass 8$\odot$) collides with a star heavier than the sun (of mass 2$\odot$) and snatches it away under its gravitational attraction. The sun is supposed to be sufficiently away from the scene of action so as not to be captured by the massive star. But it happens to be sufficiently near also to attract portions of the ribbon on which the gravitational actions of the others are balanced. It is argued, to make the situation more plausible, that the sun was a double star and that the companion, which was more massive, was enticed away by a visiting star. The planetary system is the relic of this encounter. This was described as 'the enticement theory' of the solar system by Knox-Shaw.

This theory has many features of an unsatisfactory nature. That the visiting star should be moving in the plane of the binary,

that its mass should be 8$\odot$ or more while that of the sun's companion is about 2$\odot$, that the sun should be very favourably situated to gain large chunks of the ribbon without falling into the gravitational trap of the visitor, that the ribbon should condense into planets with a large supply of hydrogen when all hydrogen is expected to escape, at the high stellar temperature, on account of the smallness of the gravitational attraction—all these make one feel that if the theory is right, "the solar system has narrowly escaped not coming into existence".[5] Lyttleton's energy manipulations require the visiting star to be one like Capella A. Such stars appear to be very rare in space and they are not the right sort, on account of the low density, for getting considerable matter (·05$\odot$) into the ribbon. Luyten[7] has, therefore, described this theory as 'astrophysically objectionable', 'dynamically untenable' and 'superlatively improbable'. We cannot say that it is dynamically untenable. But we believe that the onus is on the author to show under what circumstances it is tenable. Lyttleton has expressly avoided this, as the task undertaken by him is just to show that a solution on these lines exists.

Are we to reject Lyttleton's theory because the circumstances of the collision are highly improbable? We are not inclined to do so until another solution is in sight. But let us see what the solution offered by this theory means. Our original problem was to account for the curious regularities of the solar system. Some of them we have been able to trace to certain unusual circumstances of the origin of the system. The mysterious element has not been removed as a result of our enquiry; only its centre of gravity has been shifted. It must be admitted that when the enquiry was started by Kant or Laplace the object was to trace all the mysterious elements of the situation to general laws and unexceptional initial conditions. Apart from all this, we find that the theory is not applicable to the satellite systems of Jupiter and Saturn. Intrinsically there is nothing wrong in assuming similar exceptional circumstances to prevail for the genesis of these systems. Once we have decided to entertain the 'mystic' element in our explanations, they are not hard to discover.

What Next?

It looks as if the scientist has been blundering along like Dr. Watson in this investigation. We want a Sherlock Holmes to enter upon the scene. Probably he has been there already. But he has not yet discovered his patent clue, 'the cigarette ash', which may be anything in this about meteorites, planetoids, retrograde satellites, stars or even the comets that are so different in every way from the planets. Who knows? We may have to solve the problem of the double stars first. Our knowledge on the various astronomical fronts has advanced so rapidly in the last ten years and so many of our scientific views have been upset that the much needed clue may be found in a strange form and in an unexpected quarter. Until that happens we have to examine every bit of evidence at our disposal, by itself, and in all possible situations that are relevant.

1 Brown, E. W., *U. S. Nat. Res. Council*, 1931, Bulletin 80, Part 5.

2 Hunter, A., *Science Progress*, 1939, **33**, 760.

3 Jeans, Sir J. H., *Astronomy and Cosmogony*, 1929, p. 395.

4 Jeffreys, H., *M. N. R. A. S.*, 1932, **92**, 890.

5 Jones, H. S., *Life on Other Worlds*, 1940, 234.

6 Luyten, W. J., *Observatory*, 1938, **61**, 83.

7 —, *Ibid.*, 1940, **63**, 72.

8 —, *M. N. R. A. S.*, 1939, **99**, 692.

9 Lyttleton, R. A., *Ibid.*, 1936, **96**, 559.

10 —, *Ibid.*, 1938, **98**, 356.

11 —, *Ibid.*, 1940, **100**, 546.

12 —, *Observatory*, 1940, **63**, 206.

13 Narlikar, V. V., *Phil. Mag.*, 1931, **12**, 67.

14 *Observatory*, 1938, **61**, 167.

15 Russell, H. N., *The Origin of the Solar System*, 1935, p. 3.

16 Smart, W. M., *Stellar Dynamics*, 1938, p. 369.

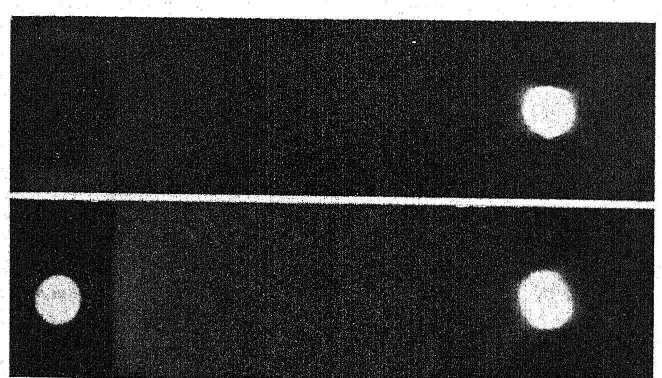
LETTERS TO THE EDITOR

RAMAN X-RAY REFLECTIONS IN DIAMOND

The work of Sir C. V. Raman and his collaborators has definitely shown that the second kind of monochromatic X-ray reflections given by the lattice planes of a crystal represent the X-ray analogue of the well-known Raman effect observed in light scattering. The appearance of these Raman reflections from the (111) planes of a diamond crystal belonging to the normal variety were discussed theoretically by the present writer in a previous paper.[1] The conclusions of that paper are in complete agreement with the observations of Raman and Nilakantan made in this laboratory and also those of Lonsdale and Smith[2] made at the Royal Institution.

In a recent letter[3] to *Science and Culture* Sirkar and Bishui have raised a few points regarding that theory. They believe that the assumption of the existence of continuously varying *long* wave-lengths for the infra-red vibrations of the crystal lattice is inadmissible. However, if one remembers that the strong coupling between the various atoms of a diamond lattice would prevent any appreciable variation of phase between the oscillations of two neighbouring cells, it is easy to realise the necessity of the phase wave-lengths of the oscillations being *very large* compared to the lattice spacing.

Another point raised by these authors is that the theoretically predicted symmetrical cross, with the Bragg reflection at its middle for the setting $\theta_i = \theta_B$ is absent with some specimens. The accompanying picture taken by Dr. Nilakantan before the publication of the theory shows the cross clearly. The intense photographic halation at the correct Bragg setting has necessitated a considerable reduction in the exposure so that the full length of the streamers is not recorded. The absence of these



a

b

Fig. 1

subsidiary phenomena in the rare type of diamond has been explained by the present

writer and Subrahmanian[4] to be due to its mosaic structure and the consequent lack of co-operation between the lattice planes of the different mosaic blocks.

Thirdly Sirkar and Bishui report that the Raman reflection for the setting $\theta_i < \theta_B$ appears as a diffuse triangular spot with its apex towards the Laue spot and not circular as required by the theory. The five pictures published in the *Proc. Ind. Acad. Sci.*, A, Vol. XIV, Plate XVII, Figs. 5 g, h, i, j, k show the circular spots demanded by the theory.

The original and later theories of Zachariasen[5, 6] give half-breadths for these Raman reflections which should be of order of the missetting $(\theta_i \sim \theta_B)$ when this is more than 1 or 2°. The accompanying pictures are taken with a narrow slit 0·2 mm. wide, 5 mm. high and 130 mm. deep and a diamond plate 4 mm. × 7 mm. × 0·76 mm. The Raman reflections take place from the (111) plane of the crystal, $(\theta_i - \theta_B)$ being $+4°42'$ and $+1°35'$ for the two figures (*a*) and (*b*) respectively.

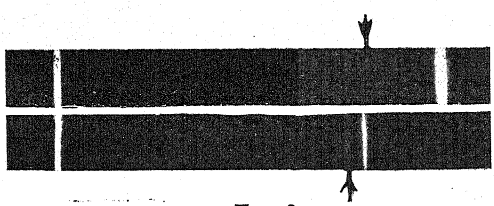


FIG. 2

The sharpness of the reflections clearly shows how Zachariasen's theories are totally inadequate to explain the facts.

The sharpness of these Raman reflections has been emphasised by the Royal Institution workers also.[7] But they avoid the inevitable conclusion as to the specular character of the new phenomenon by calling these reflections as "secondary phenomena", on the basis that they are absent in mosaic crystals of diamond, in spite of the fact that these Raman reflections are far more intense than the weak diffuse effect they have observed and which they prefer to call the 'primary'. The absence of the Raman reflections in the mosaic type of diamond simply shows the very high degree of coherence necessary between the secondary radiations from the various individual atoms to make the new phenomenon observable with crystals having large binding forces.

The diffuse effect itself can be accounted for as due to the super-lattice oscillations described and employed in a recent symposium on the Thermal Energy of Crystalline Solids.[8]

Details of this will be published later.

P. R. PISHAROTY.

Department of Physics,
Indian Institute of Science,
Bangalore,
January 16, 1942.

1 Pisharoty, *Proc. Ind. Acad. Sci.*, 1941, **14**, 56.

2 Lonsdale and Smith, *Proc. Roy. Soc., Lond.*, 1941, **179**, 8.

3 Sirkar and Bishni, *Sci. and Culture*, 1941, **7**, 314.

4 Pisharoty and Subrahmanian, *Proc. Ind. Acad. Sci.*, 1941, **14**, 439.

5 Zachariasen, *Phys. Rev.*, 1940, **57**, 597.

6 —, *Ibid.*, 1941, **59**, 860.

7 Lonsdale and Smith, *Nature*, 1941, **148**, 112 and *Phys. Rev.*, 1941, **60**, 617.

8 Raman, Norris, Anand, Dayal, Venkateswaran, *Proc. Ind. Acad. Sci.*, 1941, **14**, 459–515.

ADSORPTION AND DISPLAY OF COLOURS

WHEN activated alumina gel is dropped into a mixture of benzene and carbon tetrachloride, the white gel becomes jet black, whereas with either benzene or carbon tetrachloride, the gel develops no such colour. This extremely interesting phenomenon, briefly indicated in a former communication,[1] is found to be of a general character, as revealed by further investigations.

Sulphate in alumina has an important role in this effect. Alumina gel[1] prepared from aluminium sulphate was found to contain some sulphate in it, in spite of prolonged washing. Such a gel, after activation, always showed the colour effect. Gel prepared from aluminium nitrate showed not a trace of the colour. On soaking the above gel in ammonium sulphate

solution and subsequent heating for a short time, to activate it, the colour effect with benzene and carbon tetrachloride mixture was displayed. The gel containing sulphate was strongly ignited to decompose the sulphate. The ignited gel produced no colour. So it is definite that sulphate in alumina has an important role in producing the black colour.

In place of carbon tetrachloride in the mixture several halogen derivatives, such as (1) Methylene chloride, (2) Chloroform, (3) Tetrachlorethene, (4) Chlorobenzene, (5) Benzyl chloride, (6) Bromoform, (7) Ethylene dibromide, (8) Bromobenzene were used in combination with benzene. A mixture containing benzene and a halogen derivative would always show the colour effect. Having a trace of green or violet in some cases, the colours in different mixtures slightly differed from one another. The effect is of a general character, in being produced always in a mixture containing an aromatic nucleus and a halogen derivative.

The development of colour is gradual. The activated opaque gel on being dropped into benzene and carbon tetrachloride mixture first becomes yellow which changes over to orange red, greenish brown and finally black.

When the blackened gel is dropped into water the colour disappears. This is obviously due to the preferential adsorption of water by the gel surface. After treatment with water, the gel is white as before and the supernatant liquid colourless.

The mechanism of the development and the display of the colours is probably the formation of an adsorption complex and a precursor to the well-known Friedel and Crafts' reaction.

It is known that the characteristic absorption, of an aromatic compound shifts, on halogenation of the nucleus, from the ultra-violet towards the visible. This is probably a case of loading of the aromatic nucleus with halogen,[2] brought about by alumina-sulphate. A study of the absorption spectra of the system at various stages of development of this colour effect may throw light on the nature of this interesting phenomenon. Investigations on this line are in progress.

KITTUR SUBBA RAO.

Department of Chemistry,
Central College,
Bangalore,
December 12, 1941.

[1] Rao, K. S., and Rao, B. S., *Proc. Ind. Acad. Sci.*, 1936, **4**, 562.

[2] Suggestion by Sir C. V. Raman in a private discussion.

RAMAN SPECTRA OF 2-HYDROXY 4-METHOXY-BENZALDEHYDE

THE above substance was isolated as a white solid from the roots of *Decalepis Hamiltonii* (Kannada name, *Makaliberu*).[1] It consists of colourless rectangular platy crystals belonging to the monoclinic system.

As 4-methoxy-β-resorcylaldehyde is highly soluble both in carbon tetrachloride and glacial acetic acid, a study of its Raman spectra has also been attempted. The solutions however turn yellow after a time and the consequent absorption of the HgI $\lambda 4358$ A° decreases the efficiency of this radiation in producing Raman lines. Long exposures have however revealed two faint Raman lines at 1655 (4) and 1215 (3) cm.$^{-1}$ in a 30 per cent. solution of the substance in carbon tetrachloride. The solution in glacial acetic acid showed a few more lines (even fainter) with frequency shifts of 280 (1), 340 (1), 715 (0), 820 (0), 1345 (1), 1450 (1) and 3300 (2) cm.$^{-1}$ The lines observed in carbon tetrachloride solution appeared stronger. As the light gathering power of spectrograph employed is small, and the solution is coloured, the Raman frequencies of the substance are, it is felt, necessarily incomplete. The substance exhibits a weak fluorescence in consequence of which the Raman lines are superposed on a continuous background which extends from longer wave-lengths right up to about 800 cm.$^{-1}$ from $\lambda 4358$ A°.

I wish to acknowledge with thanks the help given to me by Dr. L. Sibaiya in the spectroscopic portion of the work.

M. SESHAIYENGAR.

Intermediate College,
Bangalore,
December 8, 1941.

[1] Srinivasa Rao and Sesha Iyengar, *Perf. Essent. Oil. Rec.*, 1923, **14**, 300.

EFFECT OF COMMON ION ON THE ELECTROLYTIC DISSOCIATION OF SOME STRONG ELECTROLYTES

DURING the course of investigations on the electrolytic dissociation by the mechanism of Raman effect, a study of solutions of strong electrolytes as influenced by the addition of some other strong electrolytes with a common ion has revealed the following phenomena.

1. The variations in the intensity of the 1045 line characteristic of HSO'_4 ions indicate that the degree of dissociation of sulphuric acid diminishes by the addition of other acids, which supply H^+ ions in abundance, *e.g.*, $HClO_4$ and HCl.

2. The variations in the intensity of the 1300 line arising out of the undissociated HNO_3 molecules show that the dissociation of nitric acid is suppressed by the addition of other acids, *e.g.*, $HClO_4$, H_2SO_4 and HIO_3.

3. The dissociation of HSO'_4 ions into H^+ and SO''_4 ions in a solution of a bisulphate, *e.g.*, NH_4HSO_4 is also found to decrease by the addition of HCl.

In all the above cases, the dissociation is diminished by increasing the proportion of the H^+ ions.

1. The dissociation of HNO_3 is found to increase by the NO'_3 ions supplied by NH_4NO_3.

2. The dissociation of HSO'_4 into SO''_4 and H^+ ions in a solution of a bisulphate is found to increase with the addition of SO''_4 ion supplied by a sulphate. This is tested in the case of mixtures of $NH_4HSO_4 + (NH_4)_2SO_4$, $KHSO_4 + (NH_4)_2SO_4$ and $NH_4HSO_4 + Li_2SO_4$.

It appears from the above results that while the behaviour of the additional H^+ ions is in conformity with the law of mass action, the anion gives results just opposed to this law. It is well known that the law of mass action does not hold for concentrated solutions of strong electrolytes, as the constant is found to vary with concentration. But, the result entirely opposed to the law obtained with the addition of the anion was never contemplated before.

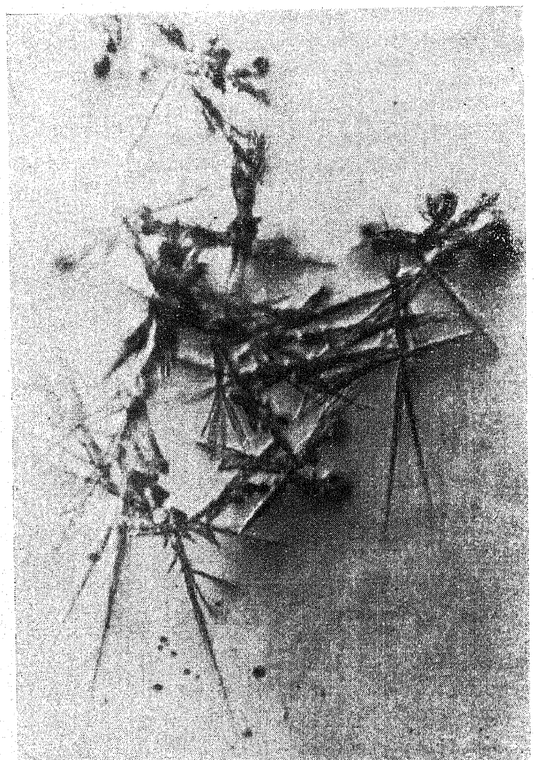
Further work with other electrolytes is in progress to permit of a generalisation as to the applicability of the law of mass action to strong electrolytes.

N. RAJESWARA RAO.

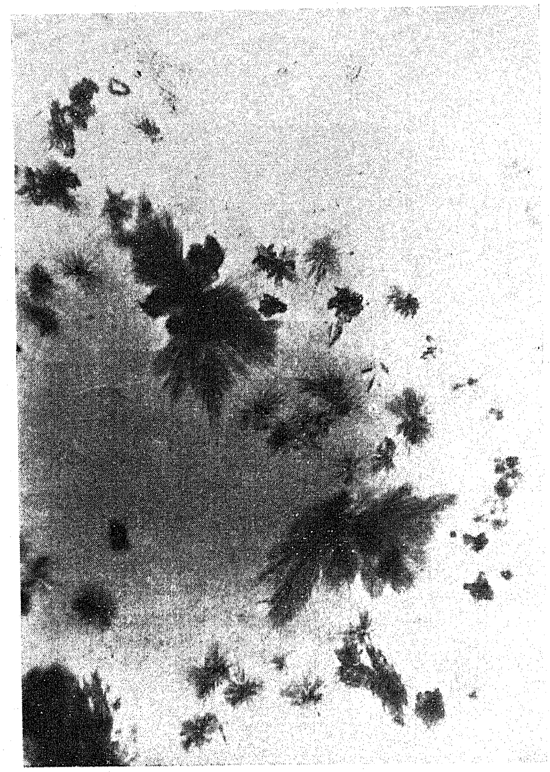
Andhra University,
Waltair,
December 29, 1941.

CRYSTALLISATION OF SOAP

IT is extremely difficult to produce crystals of alkali metal soaps (sodium palmitate, sodium stearate, etc.), though sometimes a very small amount is found to have spontaneously crystallised out of ordinary soap (technically known as 'figging' of soap) or out of aqueous soap jellies. Lawrence[1] has shown that though soaps of the very unsaturated acid like stearolic acid form microscopic crystals, the soaps of the saturated acids show it in the ultramicroscopic region. However, crystals of the acid soaps of the fatty acids can be readily prepared and McBain has published photographs of crystals of potassium hydrogen dioleate[2] and of sodium hydrogen dipalmitate[3] formed inside the melt of a mixture of neutral soap and fatty acid. McBain[4] holds that solid soap may be of two types, (i) lamellar crystals or (ii) soap curd, the latter being the more common and ordinarily producible. Of course, the soap curd fibres are really crystalline, having three-dimensional crystal regularity as indicated by X-ray evidence, though under the highest magnification even with the electron microscope, no trace of definite crystal faces are seen.[5] Thiessen and Stauff,[6] however, succeeded in producing a few crystals of sodium



Na-Stearate Crystals. × 120



K.-Stearate Crystals. × 120

stearate by a very laborious method from alcoholic solution, but they failed with sodium palmitate and laurate. Lawrence[7] in a study of soap gelation showed the existence of very irregular crude crystals of soap in soap gels in Nujol by microscopic method. This difficulty in the crystallisation of soap has precluded, so far, the employment of a crystallisation method for final purification of soap obtained by neutralising, say, alcoholic stearic acid with caustic soda.

The author has been successful in preparing crystals of alkali metal salts of long chain fatty acids. So far, the chief difficulty has been to prepare a good solvent for soap, since no organic solvent is known, in which soap dissolves to any considerable extent at low temperature. The author has surmounted this difficulty by discovering suitable mixtures of organic solvents which have powerful solvent action on soap at room temperature. The compositions of such suitable solvent mixtures have been published in a recent note.[8] On cooling such solutions, three things may happen, (i) the solution may form a transparent to translucent gel; (ii) the solution may separate a curdy precipitate or coagulum; or (iii) crystals may appear. Two or more of the above behaviours may even simultaneously occur, and what will happen depends generally on various factors, such as the composition of the mixture, the degree of supersaturation, the rate of cooling, etc. By adjusting these factors, it has been possible to prepare a good crop of soap crystals easily visible through an ordinary lens. Some microphotographs, taken in reflected light, are reproduced here. The crystals of stearates and palmitates of sodium and potassium are of the same type and were all formed at room temperature, and they have been photographed without separation from the mother liquor. These crystals consist of lamellar needles, which have a peculiar tendency to grow into foliage shape or criss-cross structure, similar to that observed for acid soap.

The crystals can be filtered out from the mother liquor, and can be properly washed and isolated. Hence, this method can be utilised for purification of ordinary alkali metal soaps by crystallisation. That even the typically amorphous substances, like proteins, resins, soaps, etc., can be crystallised under proper conditions has been amply proved by the recent crystallisation of many proteins, enzymes, etc., and the present observation only confirms this view showing that alkali metal soaps are no exception to the rule.

S. R. PALIT.

Indian Lac Research Institute,
Namkum, Ranchi,
December 18, 1941.

[1] *Kolloid-Z.*, 1930, **50**, 12.
[2] *J. C. S.*, 1927, 1392.
[3] *Ibid.*, 1933, 920.
[4] Alexander's *Colloid Chemistry*, **1**, p. 138.
[5] Vold and Ferguson, *J. A. C. S.*, 1938, **60**, 2066; Marton, McBain and Vold, *Ibid.*, 1941, **63**, 1990.
[6] *Z. Phys. Chem.*, 1936, **A 176**, 397.
[7] *Trans. Farad. Society*, 1938, **34**, 660.
[8] Palit, *Curr. Sci.*, 1941, **10**, 436.

A SIMPLE AND EFFICIENT METHOD FOR THE DISPERSION OF CALCAREOUS SOILS

PROPER dispersion of soils is an important prerequisite for carrying out the mechanical analysis. The international method of dispersion is satisfactory for many soils; but highly calcareous soils resist dispersion.[1] The black cotton soils belong to this class, and the exact cause of this behaviour has been a puzzle.[2] Our experiments with a Mysore black cotton soil (from the Government Experimental Farm, Hiriyur) confirmed the above result. A systematic investigation has revealed that the resistance to dispersion is not due to (*a*) organic matter, or (*b*) ferric or aluminium ions. It is mainly caused by the presence of calcium ions.

Since the resistance to dispersion is due to the presence of calcium ions, we have tried to overcome this by using calgon (sodium hexametaphosphate) which is well known to fix calcium and magnesium ions in the form of soluble complexes. The exact procedure adopted by us is as follows: 50 g. of soil are soaked overnight in 350 c.c. of water containing 0·32 g. of sodium hydroxide and 2·0 g. of sodium hexametaphosphate. The suspension is then stirred by means of Bouyoucos stirring apparatus for fifteen minutes and made up to a litre with distilled water. The silt and clay are determined after sedimentation for an appropriate interval of time, employing the buoyancy technique developed in this laboratory.[3] A few experiments were also tried omitting the addition of sodium hexametaphosphate with a view to find out the influence of hexametaphosphate on the extent of dispersion. The results are given in Table I.

TABLE I

Expt. No.	Dispersion using sodium hydroxide alone		Dispersion using sodium hydroxide with sodium hexametaphosphate	
	% silt	% clay	% silt	% clay
1	25·6	35·7	13·3	47·3
2	25·4	35·8	14·2	46·4
3	26·6	35·7	19·8	45·2
4	27·2	35·4	19·3	46·7
Average	26·2	35·7	16·7	46·4

The results show that the addition of sodium hexametaphosphate increases the yield of clay by about 10 per cent. Moreover, we may point out that we get a higher percentage of clay by the new method of dispersion than by the International methods or by Puri's method. The process of dispersion itself is extremely simple and very quick. We believe, it is the best for calcareous soils and possibly for other soils too. We have found that the addition of considerable quantities of calcium chloride does not materially affect the extent of dispersion in presence of the hexametaphosphate whereas, without the latter even small amounts of calcium chloride considerably reduce the

amount of clay. The details of these investigations will shortly be published elsewhere.

(MISS) G. SHARADA BAI.
K. S. GURURAJA DOSS.
BASRUR SANJIVA RAO.

Department of Chemistry,
Central College,
Bangalore,
January 10, 1942.

[1] G. W. Robinson, *Imperial Bureau of Soil Science, Technical Communication*, 1931, No. 17, p. 8.

[2] —, *Soils, their Origin, Constitution and Classification*, 1932, p. 323.

[3] (Miss) G. Sharada Bai, Basrur Sanjiva Rao and K. S. Gururaja Doss, *Proc. Ind. Sci. Cong.*, 1942, p. 206.

A CHEAP SUBSTITUTE FOR AMYL ALCOHOL USED IN THE DETERMINATION OF FAT IN MILK

OF the numerous methods in use for the estimation of fat in milk, the one due to Leffmann-Beam as modified by Gerber is widely adopted by dairy workers. This method entails the use of pure Iso-amyl alcohol. This commodity, having gone up considerably in price due to war, now selling at Rs. 14–22 per pound, attempts were made to find out a cheaper substitute for the same without in any way sacrificing the accuracy obtainable by the Gerber's method, and the one that suggested itself was Fusel Oil, a by-product in the alcoholic fermentation of molasses. The fusel oil obtained from Messrs. Carew & Co., Ltd., Rosa, Shajahanpur, U.P., contains about 60 per cent. of iso-amyl alcohol in addition to various other alcohols and costs Re. 1–8–0 only per gallon of 10 lbs.

Comparative determinations of fat in milk were made by the standard Gerber's method on the one hand and by the same method substituting fusel oil in place of amyl alcohol on the other, with the following results. The quantity of fusel oil required for a determination is the same as that of amyl alcohol.

The accompanying table shows clearly that there is a very close agreement between the two methods. The low cost of fusel oil combined with the accuracy obtained by its use must

Source of Milk	Percentage of Fat: Gerber's method	Percentage of Fat: Fusel Oil method	
Cow Rajbhani ..	6·0	6·0	Fusel Oil from Waldie & Co.
,, Lakhurki ..	5·7	5·7	
,, Nahmohini ..	10·7	10·8	
,, Edadai ..	6·4	6·4	
,, Charuki ..	6·5	6·5	
,, Edmohini ..	10·8	10·8	
,, Emdungi ..	10·6	10·6	
,, Edwa ..	5·5	5·5	
Milk from the Nutrition Room, I. A. R. I. ..	5·9	5·9	Fusel Oil from Carew & Co.
House sample A ..	5·4	5·4	
,, ,, B ..	4·8	4·8	
Local Buffalo Milk ..	4·1	4·1	

recommend itself to those engaged in milk testing. It is suggested, however, that a comparison with the Standard Gerber's test be once made, every time a fresh consignment of fusel oil is received, to be sure that it is of the desired quality.

K. SWAMINATHAN.

Imperial Agricultural Research
Institute, New Delhi,
November 27, 1941.

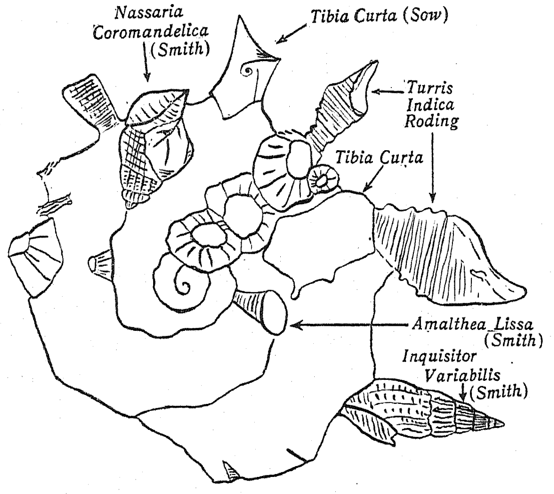
SHELL-FISH FISHED BY THE STEAM TRAWLER "LADY GOSCHEN".*

IT would be interesting to readers whose hobby is conchology to hear about some interesting finds made by the Steam Trawler "Lady Goschen", a fishing vessel which was employed by the Madras Government to investigate the possibilities of deep-sea fishing in the seas of Madras Province from 1927–30.

One of the most remarkable animals included in the hauls made off Negapatam from 75 to 80 fathoms was *Xenophora pallidula* Reeve,† a handsome spire-shell which had agglutinated to itself both live and dead shell-fish as will be seen in the sketch. Attached to the base were found several living specimens of *Amalthea (Mallurium) lissa* (Smith). The dead shells were *Turris indica* Roding, *Inquisitor variabilis*

* Published with the permission of the Joint Director of Industries and Commerce, Madras.

† I am indebted to Mr. R. Winckworth of the Royal Society, London, for naming most of the shells mentioned in this paper.



Xenophora pallidula (Rv.) 75/80 FMS. off Negapatam

(Smith), *Nassaria coromandelica* Smith, *Tibia curta* and other unidentifiable fragments of shells.

Another spire-shell in the same area which was abundant was *Murex tenuispina* a well-known species, but the shell was rather finer and with more spines than are found in those occurring in shallow water. One was not able to estimate the accurate number of specimens brought by a haul; for their delicate spines got frequently entangled in the meshes of the trawl net preventing them from falling on to the deck. Many were the complaints from the members of the crew whose bare feet had been lacerated by the sharp ends of the spines when they happened to tread unwarily on the nets. Two boring molluscs from the same area were included in the hauls, *viz.*, *Arca divaricata* (Sowerby) and *Lithophaga malaccana* (Reeve).

Specimens of the nudibranchs *Phyllida multituberculata* and of another unidentified specimen of *Phyllida* were fished off Madras from 39|50 fathoms on 24th September 1930. Specimens of the prosobranch *Lamellania* (*Coriocella*) *semperi* Bergh. with an internal shell related to *Natica* and *Cyprœa* were also fished from the same area. Most of the black coral trees (*Antipathes sp.*? and *Aphanipathes sp.*?) and Gorgonid trees brought on deck by the trawler when she trawled on the Wadge Bank off Cape Comorin and off Negapatam and Point Calimere had clinging to their branches several specimens of the aviculid *Pteria macroptera* Lamarck and of the oyster *Ostrea pectinata.* In the former were occasionally found living as its commensal the remarkable fish *Fierasfer sp.* previously recorded only from holothurians.

A list of the other molluscs fished by the S.T. "Lady Goschen" is given below:—

(1) *Harpa conoidalis* Lamarck, off Madras, 24–9–1930, from 17 fathoms, one with animal and the one with hermit crab.

(2) *Babylonia spirata* (L.) off Madras, 24–9–1930, from 17 fathoms, one shell with hermit crab.

(3) *Voluta vexillum* Gmelin, off Madras, 24–9–1930, from 17 fathoms, one specimen.

(4) *Amusium pleuronectes* (Linne), off Madras, 24–9–1930, from 17 fathoms, two specimens.

(5) *Siliquaria muricata* (Born), off Madras, 24–9-1930, from 17 fathoms, several specimens.

(6) *Fusinus forceps* (Perry), off Negapatam, 14–9-1930, from 21 fathoms, eight specimens.

(7) *Pteria semisagitta* (Lamarck), off Madras, 15–9–1927, from 35 fathoms.

(8) *Bursa rana* (L.), off Porto Novo, 1–7–1930, one specimen from 26 fathoms.

(9) *Strombus dentatus* Linne, off Pondicherry, 18–9–1930, one young specimen from 17 fathoms.

(10) *Armina formosa* (Kelaart), off Negapatam, 11–9–1930, two specimens from 76 fathoms.

(11) *Ficus investigatoris* (Smith), off Point Calimere, 10–9–1930, two specimens from 75–80 fathoms.

(12) *Tibia curta* (Sowerby), off Malpe, 30–11–1930, one specimen from 19 fathoms.

D. W. DEVANESEN.

Dept. of Industries & Commerce,
Madras,
January 2, 1942.

REVIEWS

The Chemical Action of Ultra-violet Rays. By Carleton Ellis and Alfred A. Wells. Revised and enlarged edition by Francis F. Heyroth, University of Cincinnati. (Reinhold Publishing Corporation, New York), 1941. Pp. ix + 961. Price $12·00.

This well-known book on photochemistry which appears in its second and very much revised and enlarged edition is characterised by comprehensiveness. It is divided into four parts. The first part gives a very complete account of the various sources of ultra-violet radiations, continuous and discrete, available at the moment, together with chapters on related topics such as filters and glasses permeable to these radiations. The second part on "photochemical processes" begins with an admirable short account of molecular spectra and their meaning to photochemical phenomena and gives a masterly account of the various known photochemical reactions in all three states of matter, organic and inorganic. The last two parts deal with the innumerable and evergrowing applications of photochemistry to industry and of ultra-violet rays to biology. In these, a fairly detailed account is given of the service rendered by spectroscopy in general and ultra-violet radiations in particular to various problems in applied biology and to such various industries as, preservation of foods, oils, paints, varnishes, rubber, textiles, paper, dyestuffs, leather, petroleum, gum, tobacco, alcoholic beverages, asphalt, fertilisers, linoleum, etc. In each part, references to original papers are given with a thoroughness which is necessary. The work will no doubt be of immense and constant use not only to persons working in photochemistry but also to those who are interested in industry in general.

R. K. A.

Reports on Progress in Physics. Vol. VII, 1940. (The Physical Society, London), 1941. Pp. 362. Price 22/6.

The latest number of *Reports on Progress in Physics,* Vol. VII (1940), published by the Physical Society of London is the second volume of the series which has come out after the war broke out. It is interesting to note that neither the size of the Report nor the quality of the matter has suffered on account of the war.

The present volume begins with two articles, one on Sound, and the other on Musical Acoustics, both by Dr. Richardson. He has summarised the advances in these subjects in his usual comprehensive manner. The next article is by Dr. Wright on "Photoelectric spectrophotometry and its applications to Industry". This is followed by two other articles dealing with the technical applications of science, one by Dr. Lee on "New Lens Systems" and the other on "Electron Microscopy" by Dr. Klemperer. One of the topics dealt with by Dr. Lee is the increasing use to which the Schmidt reflector is being put in the design and construction of astronomical telescopes. The growing use of the Electron Microscope in Medicine and Microbiology is the subject-matter of an interesting article by Dr. Klemperer. At the beginning of the article Dr. Klemperer gives a clear account of the construction and working of the Electron Microscope with appropriate diagrams. Photograms are reproduced to show how the Electron Microscope is a distinct improvement over the Optical Microscope in virus research where the size of the virus which is beyond the resolving power of the Optical Microscope is clearly within the range of the Electron Microscope.

Advances in Classical Physics are represented by an article on 'Surface Tension' by Dr. Brown and another on 'Equations of State' by Dr. Beattie and Dr. Stockmayer. One would have thought that these two subjects were fairly completely understood, but from a perusal of these two articles it becomes clear that the last word has not been said on these familiar topics. Messrs. Francis and Jenkins have written a comprehensive article entitled 'Electrical Discharges in Gases and their Applications' Part I. The authors have discussed briefly the present position in regard to our knowledge of this subject and further have outlined the lines on which progress is being made. It is a pity that the more useful part dealing with the practical applications of the phenomena treated could not be included in the present volume. The

next article is one on 'Some Interactions of Gases with Metals and Crystalline Solids' by Dr. Roberts. This report makes very interesting reading, no doubt due to the fact that Dr. Roberts himself has been responsible for a considerable portion of the developments embodied in the article. This is followed by a report on 'Viscosity and the Nature of Substances of High Molecular Weights in Solution' by Dr. Eirich. It is unfortunate that this article is without a bibliography so necessary in reports giving recent advances. We are told that this was due to the internment of the author while engaged on this report. Advances in Astrophysics are treated in two articles, one by Dr. Thackeray on 'Solar Physics' and the other by Dr. Hunter on 'The Absorption of Light in Interstellar Space'.

The article by Dr. Feather dealing with 'Gamma Radiations Emitted during Nuclear Processes' deserves particular notice. The whole subject is surveyed in a comprehensive manner. No one who wants to get acquainted with the present position in regard to this intriguing phenomenon connected with nuclear processes could afford to ignore this very interesting Report. The other article on Modern Physics is by Dr. Peierls on 'The Bohr Theory of Nuclear Disintegration'. This deserves special mention for the clear and lucid manner in which he has made a difficult subject intelligible to the average reader. He has achieved this by confining himself mainly to the phenomenological aspect of the theory.

Last comes a very readable article by Dr. Ferguson dealing with the history of 'The Development of the Teaching of Experimental Physics in British Universities'.

In conclusion, we warmly recommend this volume to all those who wish to keep themselves abreast of the latest developments in the realm of contemporary Physics.

B. V. R.

A Text-Book of Electricity and Magnetism. By G. R. Noakes. (Macmillan & Co., London), 1941. Pp. x + 513. Price 8*sh.* 6*d.*

Of the many text-books on electricity and magnetism so far available, the needs of the B.Sc. students of Indian universities were best met by the well-known book of Starling. That book, particularly in its most recent edition, was so good that we could not recommend a better one to our students. Here we have before us now a book which bids fair to outrival 'Starling'. On account of the fact that in this book modern developments have not been added during a process of revision, but the treatment is uniformly modern throughout, it will have a distinct advantage for some time to come over new editions of well-established texts. The even balance between pure theory and technical applications maintained in this work will recommend its adoption in preference to others where one or the other aspect has been stressed. The treatment is throughout elegant and the uniform use of the calculus has no doubt contributed to this happy result. Without sacrificing a thorough presentation of the older material, the author has succeeded in incorporating adequate descriptions of modern advances such as the Van de Graaff generator, hot cathode lamps, the M. K. S. system of units, recent determinations of the electronic charge, mass-spectrographs, electron optics, electron configurations in atoms, artificial radio-activity, the cyclotron, Heisenberg's theory of Ferromagnetism, cosmic rays, the mesotron and so on. The illustrations are numerous and well chosen. There is a set of problems at the end of each chapter and some hints for the solution of difficult ones are included at the end. The price is also moderate and compares favourably with that of similar books. We have no hesitation in recommending this book as being eminently suited to fulfil the requirements of the pass degree examinations of Indian universities.

T. S. S.

Electrotechnics (The Honorary Secretary, *Electrotechnics*, Indian Institute of Science, Bangalore), 1941. Price Rs. 2.

This is the fourteenth number of the Journal of the Electrical Engineering Society which is published once a year. The issue opens with an "Editorial" which is mainly devoted to the consideration of the relation between industrial research and industrialisation. This is perhaps a topic of special significance at the present time and some of the observations made in the course of the Editorial are interesting. It is pointed out that a mere programme of industrial research—however successful—cannot automatically lead to the industrialisation of the country. Successful research and its subsequent exploitation are two distinct problems, each beset with its own peculiar difficulties.

After describing briefly the manner in which this problem was solved by countries which were similarly situated as India is to-day, warning is given that it may turn out to be a mere waste of time and energy to concentrate on researches connected with industries which have been already highly developed elsewhere. Finally, indication is given as to what type of industrial researches are likely to prove most useful at the present time.

The Editorial is followed by a number of articles of a technical nature. These may be divided into two groups—those dealing with problems in Heavy Electrical Engineering and those dealing with problems in Light Current Engineering. In the first group there is an interesting article by Prof. E. W. Marchant describing the recent development in the Liverpool University Laboratories, thus giving information on the progress that is being made in the teaching of Electrical Engineering in Great Britain. In the second group there is an article entitled "Whistling Meteors" which reports a very interesting discovery made by the Research Department of the All-India Radio.

The articles on the earthing of neutrals and on an alteration to an X-ray unit, as also the note on Kelvin's Law, should be specially interesting to the field engineers. Standard tests on broadcast receivers form the subject-matter of an article which describes the equipment and the procedure adopted in carrying out these tests, while in another article are described briefly the processes of manufacture of fixed resistors for radio purposes. There is a topical article on the "Cyclotron", its construction and use.

Towards the end of the issue a special section is devoted to the Department of Electrical Technology, Indian Institute of Science, which gives useful and interesting information for all those connected with the Department. Other interesting items are, Book Reviews, List of Members of the Electrical Engineering Society, etc.

The Journal is maintaining its usual high standard both as regards the nature of the contents and the get-up and an important point which may be mentioned in this connection is that this is the only journal of its kind published in India.

Manufacture of Dry Cells in India. Bulletin No. 23 of Indian Industrial Research. By Joglekar, Subbramaiah and Verman.

This Bulletin is the result of more than six years' research carried out by three workers in the Research Department of the Alipore Test House. It gives a brief account of the theory of dry cells and goes on to describe in some detail their construction and operation and the raw materials and machinery used for their manufacture. The methods used for testing dry cells, defects and their remedies, etc., are also described. A short account of the economics of dry cell manufacture is also included and the Bulletin concludes with an excellent bibliography of the available literature on the subject which will be of very great use to would-be manufacturers and others interested in dry cells.

The information given in the Bulletin will serve as an excellent introduction to scientists, manufacturers and others who are not very familiar with the subject, but it is very doubtful if it will enable any one, who is not already something of an expert in the line, to produce dry cells of good quality without carrying out a considerable amount of experimental work himself. On the other hand, it is only fair to point out that would-be manufacturers could probably get any information not found in the Bulletin by consulting the authors. Most of the technical information contained in the Bulletin will be found scattered in the literature. There are a few important points, however, worth mentioning. One of these is a process (patented by two of the authors) for activating natural manganese dioxide which enables the output of dry cells to be increased by fifty per cent. Such activated manganese dioxides have been on the market for some years but were hitherto entirely of foreign origin. The authors have also devised a number of hand- and power-operated machines, for the various operations involved in the manufacture of dry cells such as the rolling of the zinc, the pressing of the dollies, etc. These machines are illustrated in the Bulletin and will no doubt prove very valuable.

A few errors of omission might perhaps be pointed out. No mention is made of the fact—well known to manufacturers of dry cells—that the state of hydration of the manganese dioxide has a profound influence on its depolarizing properties. Other things being equal, it has been found that a highly

hydrated ore has much better depolarizing properties than an ore with less water of hydration. In the account given of "Gelatinizing substances", no mention is made of potato starch which is a much better gelatinizing agent than maize starch or wheat flour. It is also rather disappointing to find that nothing has been said about a somewhat novel type of dry cell using magnesium chloride instead of the usual ammonium chloride. The "Pertrix", a German make of cell, belongs to this type and was claimed to possess several advantages, over the ammonium chloride cell, particularly with regard to shelf life, a very important factor to be considered in tropical countries. On the whole, the Bulletin is a very useful publication and every would-be manufacturer of dry cells ought to possess a copy.

C. V.

CENTENARIES

Halley, Edmund (1656-1742)

EDMUND HALLEY, a British astronomer, was born at Haggerston, London, November 8, 1656. He was educated at St. Paul's School and at Queen's College, Oxford. At the latter place he specialised in astronomy so remarkably that he was only 19 when the Royal Society accepted his first paper on the *Orbits of primary planets*.

The preparation of a new star catalogue was his ambition. But finding that project already pursued by Havellus and Flamsteed, he planned to supplement their work by the addition of the stars round the South Pole. For this purpose, he left the university before he had taken any degree and sailed for the island of St. Helena in 1676. He returned home with his catalogue of stars in 1678 when the Royal Society elected him a fellow, and Charles II gave him a mandamus to the University of Oxford for the degree of A.M.

His application for the Savilian professorship of astronomy at Oxford was rejected in 1691 on religious grounds.

Having visited the continent and having sailed in the Atlantic on various scientific missions he ultimately succeeded Dr. Wallis as professor of geometry at Oxford in 1703. Here he soon employed himself in translating from Arabic to Latin the works of Apollonius. In 1721 he succeeded Flamsteed as Astronomer Royal and devoted the next eighteen years to the duties of his office, hardly ever missing an observation.

One of the most remarkable services of Halley to science is the part he played in bringing Newton's *Principia* to the notice of the world. In January 1684 Wren offered Hooke and Halley a prize in the shape of a book worth 40 shillings if they would deduce the elliptic orbit from the law of inverse squares. Halley went to Cambridge and asked Newton, "What path will a body describe if it be attracted by a centre with a force varying as the inverse square of the distance?" Newton at once replied, "An ellipse with the centre of force as one focus". "How on earth do you know?" asked Halley in amazement.

"Why, I have calculated it", Newton said and began searching for the paper.

Halley found the papers to form a complete treatise on motion in general. With this burden of transcendental value, he hastened to the Royal Society, who wrote to Newton asking leave that it might be printed. When the consent came, Halley himself saw it through the press and met the entire cost.

The long life of this versatile man was devoted completely to the enrichment of several departments of knowledge both as an original contributor of 84 papers to the *Philosophical transactions* and as the Assistant Secretary and Principal Secretary of the Royal Society from 1685 onwards. His papers were all collected in three volumes under the title *Miscellaneous curiose*. His reputation as an astronomer rests on his discovery of the long inequality of Jupiter and Saturn and of the acceleration of the mean motion of the moon, on his prediction of the return of Halley's comet and on his suggestions for determining the solar parallax from observations on the transit of venus. His contributions to physics relate to terrestrial magnetism and optics. In pure mathematics, which he pursued only in leisure hours, he investigated the properties of loxodromic curve, first solved the problem of describing a conic section of which the focus and three points are given, improved the method of constructing curves of the third and fourth degrees and devised a new method for the tabulation of logarithms. His extensive voyages laid the foundation of physical geography and particularly meteorology. As the compiler of the *Breslau table of mortality*, he takes rank as the virtual originator of actuarial science.

In 1737, Halley was struck with paralysis in the right hand and when he was in the act of drinking a glass of wine, he expired in his chair without a groan, January 14, 1742.

S. R. RANGANATHAN.
University Library,
Madras.

FERTILITY IN MAMMALS AND BIRDS

THE problem of fertility in mammals and birds has been critically and comprehensively reviewed by John Hammond in a recent issue of the *Biological Reviews* (July 1941), under three main heads:—(1) the number of ova shed, (2) the number of ova fertilised, and (3) the number of embryos developing to birth.

That the number of ova shed and fertilised does not depend on the number of ova present in the ovary in every species was demonstrated by several workers. It was shown that the number of follicles that ripened at any one time, did not depend on the mass of ovarian substances but it depended upon the age of the animal and the level of the gonadotrophic hormone of the anterior pituitary gland circulating in the blood. Considerable amount of work has been done on this hormone, the hormones of the urine of pregnant women and the hormone in the blood serum of pregnant mare. Of late, these hormones are being extensively used in the field to increase the fertility in mammals.

In early life, while growth is rapid the ovaries remain inactive and in old age, senility inactivates the ovaries. It is only in the middle age, that the maximum number of ova are ripened. As a result of several investigations, it has been shown that it is the age of the animal which influences the ripening of follicles and immature animals lack sufficient gonadotrophic hormones of the anterior pituitary circulating in the blood. Though the growth hormone and the gonadotrophic hormone of the anterior pituitary have something to do with each other, the exact relationship between them is not yet clear. In some species the lactogenic hormones in some way, inhibit the ripening of follicles.

Seasons definitely influence the rate of reproduction in mammals and birds; breeding is at the maximum in most of the species when the duration of the day is longer. This is due to the increased activity of the anterior pituitary gland stimulated by the nerves of the eyes which are acted upon by light rays. In non-breeding seasons the lowered output of the follicle stimulating hormone of the anterior pituitary may be raised by the injection of follicle stimulating hormone. But before fertility can be induced other conditions such as the occurrence of oestrus and correct timing of this in relation to ovulation must be satisfactory. Under these favourable conditions, successful mating and fertilising may be effected.

Ovarian cysts and a persistent corpus luteum interrupt the normal course of fertility. Ovarian cysts are of two kinds. The follicle, under certain conditions, does not rupture but progressively increases in size to form a cyst. In extreme cases the female with cystic ovaries assumes male sexual characters. Though the cause of cyst formation is not known, it can be artificially produced by injecting Prolan. The cysts either prevent further ovulation or produce large quantities of Oestrin which prevents the implantation of the ovum or cause abortion.

The number of ova fertilised is not only affected by the number and vitality of the sperm produced by the male but also by the duration of life of the sperm in the female genital tract and the time relation between mating and ovulation. The sperm and the ovum have a very limited independent life in the female tract and hence the chances of fertility are very remote if the time relations between mating and ovulation are not properly synchronised.

For maximum fertility it was observed that the production of large number of vigorous sperm is essential. In many of the mammal species defective sperm production leads to low fertilisation of the ova. Defective sperm production is produced by infections and obstructions in the tubules of the epididymis, faulty nutrition, deficiency in one or other vitamin, especially Vitamin E, the semen becoming alkaline under certain conditions and small differences in temperature.

Artificial insemination is playing an important role in the science of breeding. By this new method the fertility of males of high genetic value has been augmented. Recently, this has attained greater importance than the problem of curing certain forms of sterility in males.

In many species mating is limited to a short period of oestrus which occurs just before ovulation, and if mating does not occur within that short period the ovum is wasted. Other factors that affect fertility are the conditions in the female tract such as the presence of inflammation and leucocytes or the incomplete liquefaction of the mucus of the cervix at the time of oestrus.

During the course of pregnancy in mammals and incubation in birds, numerous conditions may interfere with the development of the embryo. In the event of conception, the corpus luteum formed at the ruptured follicles and progestin, the internal secretion of the corpus luteum, watch over the implantation of the embryo in the uterus and persist right through the pregnancy until a few days before the first oestrus following parturition. Under certain conditions, the progestin secretion is absent or deficient which leads to the failure of implantation. In certain species lactation at the period interferes with the process of pregnancy.

Progestin which is essential for the maintenance of pregnancy is produced also by the placenta. Under certain conditions the influence of Oestrin will over-ride that of progestin when, if it is in the early stages of pregnancy, absorption occurs, but in the later stages of pregnancy, abortion takes place. Certain infections as those due to Bang's bacillus and inflammatory conditions as those due to metritis also lead to abortion.

In many species certain lethal genetic factors will cause the death of one or more embryos at or before birth or hatching. In these cases only those embryos involved perish and others undergo the full term of development. These dead ones may become atrophied and mummified. There is every reason to believe in the existence of a substance in the blood which limits the number of young that develop normally to birth. The nature of this substance awaits future investigation.

K. SUBRAMANIAN.

SCIENCE NOTES AND NEWS

A Pyralid Caterpiller Pest—*Nephopteryx eugraphella* Rag.—on Sapota.—Messrs. M. C. Cherian and K. P. Anantanarayanan, Entomological Laboratory, Agricultural Research Institute, Coimbatore, write:—

The occurrence of this Pyralid caterpillar in pest form was first noted in Coimbatore in 1938. The same insect recurred again in a more virulent form in the summer of 1941. Very little is known regarding the life-history and control of this insect, though Fletcher (1920) has noted this pest elsewhere as early as 1920 on sapota and also on *Mimisops elengi*. During recent studies some useful information has been gathered on this insect.

The affected tree is readily recognised from a distance by the presence of numerous webbed shoots, dry leaf clusters and dark brown patches on leaves containing tunnels and frass of the caterpillar. The insect does a lot of damage to the leaves, and in addition, destroys a number of successive flower buds which eventually dry up and droop. The whole life-cycle is passed on the leaves and shoots. Eggs are laid on leaves and buds of tender shoots. After an egg period of 3 to 5 days the active larvæ bore into the buds or scrape the green leaves. Pupation is effected in folds of leaves and further sheltered by the tunnels of silken webs and frass after a varying larval period of 17 to 32 days. In about 7 to 12 days the moth emerges. The moth is greyish in colour, sluggish and rests on twigs during day. The moth is not easily detected, its colour pattern being well in harmony with that of the bark. A stomach poison, such as calcium arsenate is very effective in controlling this insect. Other cheaper insecticides are also being tried.

January 6, 1942.

Ancient Town Site at Arikamedu.—A few years ago Prof. Jouveau-Dubreuil and Frere Faucheaux of Pondicherry found ancient-looking beads and potsherds from a mound on the right bank of the Gingee or Ariyankuppam river near Kakkayantope village, south of Pondicherry. The site has been described by Prof. Jouveau-Dubreuil in *Bull. de l'Ecole Francaise de 'Extreme Orient,* 1940, 40, 2. Among the remarkable surface finds was an oval carnelian plaque with the figure of Emperor Augustus. Prof. Jouveau-Dubreuil generously presented a collection of beads and potsherds to the Madras Government Museum. The beads, according to M. Cortenau, could be dated circa 500 B.C. The beads and pottery bore close resemblance to those from Buddhist sites of the Andhra country. Among the surface finds were terracotta figures of great excellence, coins of Andhra kings, various fragments of articles made of glass of diverse shades of colour, and sherds of ornamental grey ware and of cream coloured amphoræ.

Recent trial diggings brought from near the foundations of ancient walls, fragments of inscribed pottery, the characters of the inscription being Brahmi of the second century B.C. Some other characters on the pottery appear to be unreadable.

Arikamedu goes back thus to the early centuries of the Christian era, and is definitely the most ancient archæological site yet discovered in the Tamil country. The Government of French India are taking steps to protect the site and a Committee has been appointed to consider details.

A. A.

Tuberculina which belong to the group of Fungi imperfecti are hyperparasitic on many rusts. They possess hyaline conidia and smooth sporodochia. In Europe experiments have been carried out to use them as a means of controlling the devastating effects of the pine rust *Cronartium ribicola*. Hubert, Tubeuf and others report partial success in utilising *Tuberculina maxima* as a means of biological control of the pine rust. *Tuberculina costaricana* was collected by the writer on the Jasmine rust (*Uromyces Hobsoni*) round about Bangalore. The fungus parasitises pycnia and æcia of the Jasmine rust, and in most of the cases effectually prevents the development of teliospores. The suppression of the resting spore-form might prevent the perpetuation of the disease from season to season.

M. J. T.

Voltametric Determinations and Amperometric Titrations with a Rotating Microelectrode of Platinum Wire.—Current voltage curves obtained with various types of microelectrodes are discussed by Laitinen and Kolthoff (*J. Phy. Chem.* 1941, 45, 1079). The advantages of the rotating platinum microelectrode, which gives a diffusion current proportional to the concentration in a medium of constant salt concentration, over stationary platinum microelectrode have been pointed out. Two types of rotating platinum microelectrodes are described in detail. The reduction of oxygen on the electrode has been studied using rotating platinum and silver plated electrodes. It has been found that oxygen is reduced at a less negative potential at the silver surface than at the platinum surface and further the diffusion current is not well defined with the silver electrode. Amperometric titrations of very dilute solutions of arsenite with bromate and silver with chloride using the platinum electrode are described. Use of gelatin is suggested to prevent the depolarising action of silver chloride. It is likely the method may be found useful in other specific cases. An explanation for the abnormal slopes of current voltage curves is given.

M. R. B.

Plate Factors in the Fractional Distillation of the Ethyl-alchohol-Water System.—The results of a very valuable study on plate efficiency,

carried out at the Engineering Experiment Station, Urbana, in a bubble cap column of four plates, operated without entrainment at vapour velocities 0·2 to 3 ft. per second and at reflux ratio $L/V = 1$, $^2/_3$ and $^1/_9$ have been published (*Bull. of the Univ. of Illi.*, 1941, No. 328). The plate efficiency was found to vary with the liquid composition but not significantly with reflux ratio or rate of distillation. The Overall Murphree efficiency rises from 80 to 100 per cent. from 10 to 60 mole per cent. alcohol, in the liquid and decreases to 60 per cent. at 80 mole per cent. alcohol. The local plate efficiency varies from 80 to 50 per cent. with 50 to 80 mole per cent. alcohol in liquid. It is interesting to note that the 'median' efficiency reaches a maximum in the range of maximum viscosity in the liquid, between 20 and 40 mole per cent. alcohol. As vapour bubble size varies inversely with liquid viscosity, at maximum viscosity, bubble size is minimum. The observation lends support to the condition of a formation of heavy froth, below the point of appreciable entrainment, considered by designers as necessary to maintain high plate efficiencies. The low efficiencies at the extremes of the composition range, where the diffusional driving force is small, cannot be definitely attributed to the influence of liquid composition. As these calculations are inherently unsatisfactory and sensitive to errors in sampling, etc., the actual performance of a distilling column cannot be predicted. Hence in practice a larger number of plates are provided to safeguard against variations in design and operation.

The above study presents a marked advance in the definite knowledge of several factors influencing distillation and the *Bulletin* is a useful guide to designers of plant as well as to research workers. The *Bulletin* includes a review of previous work, a discussion of efficiency calculations, experimental data, an appendix of physical data for ethyl-alcohol-water mixtures and a bibliography.

Y. K. R.

Mysore Geological Department.—The latest number of the *Records of the Mysore Geological Department* (Vol. XXXIX) begins with the Director's Annual Report on the administrative and technical work of the Department during the year 1939–40. Then there are six papers contributed by the officers of the Department dealing with various problems of scientific and economic importance investigated by them in the course of the year. Mr. B. Rama Rao, the Director, leads with an important paper on "The Charnockite Rocks of the Biligirirangan Hills". From his study of the rocks described by previous workers as Charnockites near Sivasamudram, Malvalli, Halagur and other parts of the State, Mr. Rama Rao has been expressing the view that "the zones mapped as Charnockites form a complex composed of a composite series of rocks of different ages and diverse modes of origin, all intensely metamorphosed, and that they cannot all be regarded as the differentiated phases of crystallisation of any single, plutonic, intrusive mass." The present paper deals with the Biligirirangan Hills area and embodies a detailed account of the typical character and the field relations of the several rock types found in this area which have been distinguished and mapped previously as Charnockites. A discussion of the wider aspects of the age relationship and the mode of origin of the Charnockites in general has been reserved for a separate paper to be published some time later. Mr. M. B. Ramachandra Rao's "Report on the Geophysical Survey near Guddadarangavanahalli in Chitaldrug District," is of particular interest as recording the results of a new line of investigation recently initiated by the Department, with the object of studying the practical application of some of the electrical methods for the location of ore bodies. After giving a brief outline of the general principles of the methods adopted, together with descriptions of the apparatus employed, Mr. Rao proceeds to describe in detail the actual field surveys carried out and discusses the interpretation of the results obtained. He concludes: "The investigations embodied in this report were largely of an experimental nature, and it has not yet been possible to fully verify the few important indications by actual prospecting work." The other four papers contained in the *Records* are: (*i*) Earth-salt Deposits in the Shimoga and Chitaldrug Districts, by Mr. N. M. Mallikarjunappa, (*ii*) Petrology of the Felsite and Porphyry dykes in Mysore, by Mr. B. N. Raghunatha Rao, (*iii*) Notes on Prospecting for Alluvial Gold round Kudurekonda and Palavanahalli, Honnali Taluk, Shimoga District, by Mr. B. P. Radhakrishna, and (*iv*) The Conglomerates of Kalavaranganbetta, Honnali Taluk, Shimoga District, by Mr. B. P. Radhakrishna, and all of these furnish valuable information on the topics dealt with.

Department of Chemical Technology, University of Bombay (*Annual Report*, 1940-41).—The Department has continued to maintain contact with the textile and chemical industries of the province, as evidenced by the employment of its graduates, the subsidies received for industrial research, and the increasing amount of analytical work and technical investigations submitted to the Department. Among others a wool research scheme has been started under the auspices of the Imperial Council of Agricultural Research for investigating the possibility of effecting improvements in the quality of Indian wool, and for setting up standards for Indian wool.

The foundation stone of the new buildings for the Department was laid in March 1941. It is planned that the Department will finally shape itself into a University College of Technology, with additional degree courses in 'Plastics, Paints and Varnishes', 'Oils and Fats', 'Paper and Cellulose Industries', Pharmaceuticals and Fine Chemicals', and 'Foods and Drugs'.

Irrigation Research.—Reports on the research work carried out at the various centres were reviewed and the programme for 1942 was drawn up at the 12th annual meeting of the *Central Board of Irrigation* held in Delhi recently.

The Board considered the work done relating to the staunching of canals to prevent leakage. Considerable work on the subject has already been done in view of its importance.

Some instances of the success of the measures adopted for carrying out model experiments were reported to the Board. One was the Beas river model, on which the construction of armoured "T" head spurs in the river Beas was decided. It was emphasised by the engineers concerned that if they had not had the model, the results of erosion might have been serious. The Board decided to collect further data comparing the behaviour of a prototype to that of its model, for various types of models.

Work done in connection with the meandering of rivers, design of channels in alluvium, the accuracy of different methods of taking discharges, and silt selective heads was discussed. Some channels taking off from larger ones draw excessive silt which causes considerable trouble in the off-taking channel. This, it was considered, could be remedied by a suitable design of head of off-take, *viz.*, a silt selective head, arranged to draw the correct proportion of silt. The design depended on many factors which differed at different sites. Model experiments were of great value in this connection. The Board asked the Research Committee to indicate the types of silt selective heads best suited to different conditions.

The design of silt excluders and ejectors was also considered as well as methods of calculating the head required to operate such devices. The silt excluder withdraws the heavy bed sand at the head-works and so prevents it from entering a canal, whereas a silt extractor is constructed on the canal to extract heavy silt or sand which is being carried down the canal.

One of the problems on which much research has been done in America is the deposit of silt in reservoirs year by year reducing their capacity. A large amount of data on the subject has also been collected in India and Burma. The subject is one of general interest to the Board, but particularly to those provinces which have in hand schemes for the construction of storage reservoirs, such as the Bakhara Dam in the Punjab.

Agricultural meteorology.—A number of new problems of practical importance to agriculture, which were suggested recently by the Agricultural Commissioner with the Government of India, are being dealt with by the Agricultural Meteorology Section of the India Meteorological Department. This Section was taken over by the Department in April 1940, as its work is of permanent value to Agriculture in India. The physics of sub-soil irrigation involving measurements of the rates of upward and downward movement of moisture through the soil from the sub-soil level, the wind-break effect of different crops as measured by the variation of wind velocity in the different environments with the help of a hot-wire anemometer, the effect of shade plants on the climate of tea-gardens, weather factors influencing the incidence of insect pests and the investigation of the influence of weather on cane and sugar tonnage per acre, are a few of the problems which are receiving the attention of the research staff.

Considerable attention is devoted to the development of new instruments for the use of agricultural workers in India. To facilitate the experimental work of the Section, the construction of a field laboratory at the Central Agricultural Meteorological Observatory was completed recently and an additional plot of land has been placed at the disposal of the Section by the authorities of the Agricultural College, Poona.

Fish Canning.—A "mobile cannery" with the canning plant installed on board a large sailing or power-propelled boat, as is often done in Japan, is suggested by the Agricultural Marketing Adviser to the Government of India as a more suitable method for developing the fish canning industry in India.

The Indian migratory fishes are rather erratic in their movement. They do not touch the shores of India each year with any degree of regularity. Further, the difficulties of transporting the catches (including 40 per cent. or more of non-cannable waste) from distant waters to the cannery on the shore form a serious problem in tropical climates. A mobile cannery is both convenient and economical.

Previous to the present war, on an average, 44,000 cwt. of canned fish valued at over 10 lakhs of rupees used to be imported into India from the United Kingdom, Canada, Norway and Japan. Fish canning industry in India has now assumed increased importance owing to supplies having been cut off from these sources.

Experiments in canning Indian fish were first conducted at an experimental canning factory opened by the Madras Government at Chalyam (Malabar) as early as 1911. These experiments showed that, besides oil sardines, a number of other fishes, such as mackerel, pomfret, Indian salmon and prawns, could be advantageously canned. The Government cannery, however, was not a commercial success and in 1933 was sold to a private party, who has re-equipped it not only for canning of fish but also of fruits and vegetables. Small lots of sardine and mackerel in olive oil have been prepared already. Efforts at canning Indian fish are being also made at two fruit canning establishments, operating at Bezwada and Bombay.

The average annual catch on the British Malabar and South Kanara sea fronts of the Madras Presidency is about 2,607,000 maunds, of which approximately 60 per cent. consists of varieties which are suitable for canning. They are: mackerel—985,000 maunds, oil sardines—371,000 maunds, prawns—108,000 maunds, seer fishes—40,000 maunds, pomfrets —10,000 maunds and beckti—5,000 maunds.

Canning and Food Preservation.—Canned and dried foods, particularly fruits and vegetables which on account of their vitamin content are of special value to troops, have assumed a special importance in view of the enormous

armies moving rapidly and operating at long distances from the base.

In order to secure easily transportable supplies of food in a form which will keep them intact in any climate, the Supply Department created a Food Directorate in 1940 with which the Imperial Council of Agricultural Research has been working in collaboration.

Manufacture of Surgical and Orthopaedic Instruments.—India is now a predominant instrument producer among the Eastern Group countries and practically 100 per cent. of hospital and operation theatre equipment and 98 per cent. of orthopædic instruments and appliances are now produced by the Indian industries.

Planning is in progress for the production during the next twelve months of five million instruments and appliances by the Indian surgical instruments industry.

The Medical Store Department has been the main instrument in developing the manufacture of surgical instruments in India. Some 25 years ago, a surgical instruments factory was established in Bombay. As Departmental demands increased it was found necessary to stimulate the production in other parts of India and now the surgical instruments industry is well established in Lahore and Sialkot in the Punjab.

Manufacture of Optical Instruments.—*The Mathematical Instrument Office,* Calcutta, has been performing an increasing amount of work for the Defence Services, particularly in respect of optical instruments. It is now manufacturing, in large quantities, binoculars (not hitherto produced in India), prismatic compasses and other optical instruments for the army, as well as mathematical and surveying instruments. Experiments have also been in progress for some time in the manufacture in India of optical glass.

Forest Research Institute.—A large volume of research of immediate interest to war industries, has been recently carried out at the Institute. To mention a few of its activities, investigations have shown that 75 per cent. of the timber used in modern aircraft (aircraft in its widest sense), is made up of short 10-feet lengths, and a careful selection of Indian spruce and fir can supply such timber. Certain other species, almost unknown and untested in time of the last War, have since been found which appear to answer the requirements. The Institute has also been making aircraft propellers in sissoo, walnut and Andamans *Padauk*. As the result of experiments, a sleeper creosoting plant at Naharkhatya in Assam has been reopened and will soon be treating green sleepers straight from the forest for the use of armies overseas. A special type of synthetic resin glue for plywood and laminated wood, which is an essential material for army supplies, has been evolved at the Institute.

A hot air seasoning chamber has been recently devised which is much cheaper to instal than an ordinary seasoning kiln.

A simple key to identify six-species of bamboos in their finished states as tent poles has been devised by the Botanical Branch of the Institute, helped by the Silvicultural Branch.

Manufacture of Newsprint.—Suitable mechanical pulp for use in the manufacture of newsprint quality papers has been produced at the Forest Research Institute, Dehra Dun.

For the production of the required mechanical pulp, the Paper Pulp Section of the Institute experimented with nine species of woods and one species of bamboo (*salia*). Five of the woods (*genwa, paper mulberry, chir, fir* and *spruce*) yielded fairly light-coloured pulps, suitable for use in the manufacture of newsprint quality papers.

Papers were produced on the Forest Research Institute's small experimental paper machine from a mixture of 70 per cent. mechanical pulp and 30 per cent. bleached bamboo chemical pulp, and their strength characteristics were determined. With fir and spruce, the proportion of mechanical pulp and bamboo pulp was 75 per cent. and 25 per cent. respectively, and the papers produced from these woods were comparable in strength to the average imported "newsprint" papers.

Fir and spruce are available in Kashmir and Tehri Garhwal States in sufficiently large quantities to support a small newsprint mill. The proposals for the establishment of a mill in each of these two States has, however, had to be held up till after the war, for various economic and technical reasons, the chief of which is the abnormally high capital investment required for putting up a mill at the present time.

The remaining four species of wood and the *salia* bamboo, yielded brown or brownish coloured pulps. These pulps on account of their brown colour were not considered suitable for the production of newsprint quality paper, but they can be utilised for the manufacture of certain cheap lines of paper, such as cheap printing and wrapping papers, triplex boards and cheap cardboards.

Experiments are now in progress to find out a cheap and economical method of bleaching or lightening the brown colour of mechanical pulp, especially from bamboo, as this material (bamboo) is available in India in large quantities.

New Uses for Jute.—The December issue of the Indian Central Jute Committee's *Bulletin* contains some interesting information on several new uses of jute. Production of a cork substitute on a patented jute waste base has commenced in Calcutta. A new method for making felts on jute fibre base has recently been patented. Felts produced according to this method are claimed to be rot-proof, termite-proof, waterproof and resistant to heat of the sun.

Another announcement of considerable interest is the reported use of jute by the Ford Motor Company as a base for a plastic composition for the manufacture of car and truck bodies.

ASTRONOMICAL NOTES

Planets during February 1942.—Mercury after inferior conjunction with the Sun on February 10, passes into the morning sky. Venus also will be in inferior conjunction on February 2 and during the latter part of the month will be visible in the morning sky for about a couple of hours before sunrise. On February 22, the planet will be at one of the stationary points of its geocentric orbit. Mars is in the evening sky and although gradually decreasing in brightness, its ruddy colour makes it a prominent object among the stars in the constellation Taurus.

Jupiter will be on the meridian at about sunset and continues to be bright enough to attract attention. Saturn is in quadrature with the Sun on February 11 and can be seen as a star of the first magnitude in the western sky during the early part of the night. The planet will be in conjunction with Mars on February 24 when the angular distance between the two will be a little over three degrees. Uranus will be stationary on February 3 when it resumes its slow eastward motion among the stars in the constellation Taurus. On February 15, the planet is in quadrature with the Sun. An occultation of considerable interest that can be observed with the naked eye is that of the first magnitude star Aldebaran (α Tauri) which will occur in the early part of the night on February 23. The disappearance of the star as well as the reappearance will be visible in India.

T. P. B.

MAGNETIC NOTES

December 1941, was slightly less active than the previous month. There were 13 quiet days, 16 days of *slight* disturbance, one of moderate disturbance and one of great disturbance during December 1941, as compared with 6 quiet days, 22 days of slight disturbance and 3 of moderate disturbance during December 1940.

The day of the largest disturbance during December 1941, was the 1st when a magnetic storm of great intensity was recorded. The quietest day was the 20th.

Characterisation of individual days was as follows:—

Quiet days	Disturbed days		
	Slight	Moderate	Great
5, 11, 12, 15, 16, 19–22, 26, 28, 30, 31	2–4, 6–10, 14, 17, 18, 23–25, 27, 29	13	1

During December 1941, one storm of great intensity was recorded as against one of moderate intensity recorded during December 1940. The mean character figure for the month was 0·65 as against 0·90 for December 1940.

M. R. RANGASWAMI.

SEISMOLOGICAL NOTES

During the month of December, 1941, one great, three moderate and three slight earthquake shocks were recorded by the Colaba seismographs as against one moderate and seven slight ones recorded during the same month in 1940. Details for December are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T. H.	M.	Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
December 1941		H.	M.	(Miles)		(Miles)	
6	Great	2	17	10580	Lat. 0°, Long. 90° W. Off Equador (S. America)		
7	Moderate	2	55	10510			
9	Slight	8	13	3520			
13	Slight	11	46	3110			
17	Moderate	0	50	3130	In the neighbourhood of Formosa Island		
23	Slight	16	59	1380	Apparently in Tibet		
26	Moderate	20	18	1850	Lat. 20° N., Long. 101° E. To the east of Burma on the border of Thailand and Indo-China	Probably about 60–80	

ANNOUNCEMENTS

Indian Science Congress, 1943.—The next session of the Congress will be held at Lucknow from January 2–8, 1943. PANDIT JAWAHARLAL NEHRU, Chairman, National Planning Committee, will preside over the session.

The following have been elected Presidents of the different Sections:—*Physics*: Dr. H. J. Bhabha (Bangalore); *Chemistry*: Dr. S. S. Joshi (Benares); *Geology and Geography*: Lt.-Col. E. A. Glennie (Dehra Dun); *Botany*: Dr. K. Biswas (Calcutta); *Zoology*: Dr. B. N. Chopra (Calcutta); *Anthropology and Archæology*: Dr. N. Chakrabarti (New Delhi); *Medical and Veterinary Sciences*: Dr. F. C. Minett, (Mukteswar); *Agricultural Sciences*: Rao Bahadur Y. Ramachandra Rao (Bangalore); *Physiology*: Dr. B. Narayana (Patna); *Psychology and Educational Sciences*: Dr. B. L. Atreya (Benares); *Engineering and Metallurgy*: Prof. K. Aston (Bangalore).

Ramalinga Reddy Sastyabdapurti Commemoration Volume, Part I—Sciences.—The learned articles that were presented by scientists from different parts of India to Dr. C. R. Reddy, Vice-Chancellor, Andhra University, on the occasion of his *Sastyabdapurti* in December 1940, have now been published in a collected form. The sale proceeds will be utilized for the benefit of the Andhra University to which Dr. Reddy's donations amount nearly to half a lac of rupees. As only a limited number of copies are available, intending purchasers are requested to register their orders early with the Registrar, Andhra University, Waltair.

A new service of **Biological Abstracts.**—To meet the requirements of men engaged in the animal industries, *Biological Abstracts* announces the establishment of a new section, *Section F, Abstracts of Animal Production and Veterinary Science*, beginning January 1942.

The biological research literature on the breeding, nutrition, husbandry, diseases and pests of the domesticated animals—including poultry, fur-bearing animals and pet stock—is scattered throughout a large number of original research journals in many languages, and its assembly, in the abstract issues and indexes of a single comprehensive abstracting journal will, it is felt, be a great convenience to all who are working in the broad field of animal production.

The new section will consist of ten abstract issues per year. The annual subscription rate will be $5. Subscribers will receive the index to the complete edition of *Biological Abstracts*.

Section F will contain all of the abstracts published in *Biological Abstracts* that have to do with the breeding, nutrition, and metabolism, husbandry, reproductive and other physiology, anatomy, pathology and parasitology, and arthropod pests of live-stock, poultry, and semi-domesticated animals and birds, including pet stock.

Biological Abstracts now covers some 1,450 periodicals—thus the new abstracting section will, from the beginning, afford a very complete coverage of the biological literature pertaining to the animal industries.

Inquiries should be addressed to *Biological Abstracts*, University of Pennsylvania, Philadelphia.

Dr. B. V. Narayanaswami Naidu, Annamalai University, has been elected President of the Economic Conference, to be held in December 1942, at Madras.

Ceylon Journal of Science.—The Editor-in-chief, *Ceylon Journal of Science*, informs us that the publication of "Spolia Zeylanica" issued in December 1941 from the Colombo Museum as Vol. XXIII, Part I, has no connection whatever with the *Ceylon Journal of Science*, the Editorial Board of which disclaims any responsibility in connection with the said publication.

Indian Research Fund Association.—The attention of our readers is drawn to an advertisement appearing in the December 1941 issue (Vol. 10, No. 12), inviting applications for five Research Fellowships of the value of Rs. 150 each per mensem under the Indian Research Fund Association. Applications should reach the Secretary, I.R.F.A., Secretariat, New Delhi, not later than 7th February, 1942.

* * *

We acknowledge with thanks, the receipt of the following:—

"Journal of Agricultural Research," Vol. 63, Nos. 4-6.

"Agricultural Gazette of New South Wales," Vol. 52, Pt. 11.

"Journal of the Indian Chemical Society," Vol. 18, No. 9.

"Chronica Botanica," Vol. 6, Nos. 17-18.

"Experiment Station Record," Vol. 85, Nos. 4-5.

"Indian Forester," Vol. 68, No. 1.

"Indian Farming," Vol. 2, No. 12.

"Indian Journal of Genetics and Plant Breeding," No. 1, Dec. 1941.

"Bulletin of the American Meteorological Society, Vol. 22, No. 8.

"Journal of the Indian Mathematical Society," Vol. 5, No. 3.

"Journal of the American Museum of Natural History," Vol. 48, No. 3.

"Nature," Vol. 148, No. 3755.

"Canadian Journal of Research," Vol. 19, No. 8.

"Sky," Vol. 1, No. 1.

"Indian Trade Journal," Vol. 143, Nos. 1851-53; Vol. 144, Nos. 1854-55.

BOOKS

"The Cytoplasm of the Plant Cell," by Alexandre and Guilliermond. (The Chronica Botanica Co., Waltham, Mass., Macmillan & Co., Ltd., Calcutta), 1941. Pages 247, Price $4.75.

"Landscape as developed by the processes of normal erosion," by C. A. Cotton. (Cambridge University Press, London), 1941. Pages xviii + 301. Price 21*sh*.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences: (*Proceedings*)

December 1941. SECTION A.—R. D. DESAI AND F. FIGUEREDO: *Studies in the Friedel-Crafts reaction. Part VII. The action of phthalic and succinic anhydrides on resorcinol derivatives.* S. V. ANANTAKRISHNAN, S. ARAVAMUTHACHARI AND V. S. GOVINDARAJAN: *A study of the constituents of the seeds of* Croton sparsiflorus (*Morung*)—*Part I.* S. V. ANANTAKRISHNAN, S. ARAVAMUTHACHARI AND V. S. GOVINDARAJAN: *A study of the constituents of the seeds of* Croton sparsiflorus (*Morung*)—*Part II. Chemical examination of the components.* K. GANAPATHI, M. V. SHIRSAT AND C. V. DELIWALA: *Chemotherapy of bacterial infections. Part V. Synthesis of 2-N¹-sulphanilamido-5-alkyl- and 2-N¹-sulphanilamido-4-m e t h y l-5-alkyl-thiazoles.* N. V. R. IYENGAR: *Modified methods for the determination of total alkali, sulphate, nitrate and phosphate in highly coloured solutions of high organic matter content.* The analysis of highly coloured and turbid effluents has been much simplified by the previous oxidation of colour and organic matter by hydrogen peroxide under suitable conditions. P. SURYAPRAKASA RAO AND T. R. SESHADRI: *The colouring matter of the flowers of* Tagetes patula: *Isolation of a new flavonol, patuletin and its constitution.* Patuletin is represented as 3:5:6:3′:4′-pentahydroxy flavone. B. R. SETH: *Finite strain in a rotating shaft.* BIJAN BIHARI LAL: *Decomposition of hydrogen peroxide by sodium nitroprusside.* The photo-chemical after-effect in the reaction between hydrogen peroxide and sodium nitroprusside is due to the photo-formation of sodium aquo penta cyano ferrate. MISS S. PANKAJAM: *Ideal theory in boolean algebra and its application to deductive systems.*

SECTION B.—B. SAHNI: *Indian silicified plants. I.* Azolla intertrappea *Sah. & H. S. Rao.* K. CHIDAMBARAM: *Observations on the development of* Arius jella (*Day*). L. S. S. KUMAR AND A. ABRAHAM: *Cytological studies in Indian parasitic plants. I. The cytology of* Striga. M. C. CHERIAN AND M. S. KYLASAM: *Preliminary notes on the parasites of the spotted and the pink bollworms of cotton in Coimbatore.* A. R. SRINIVASAN: *Cyto-morphological features of* Limnanthemum cristatum *Griseb. and* Enicostemma littorale *Blume.* K. BHASKARAN NAIR: *On the embryology of* Squilla.

Indian Chemical Society: (*Journal*)

September 1941.—S. S. BHATNAGAR AND M. SARUP: *Adsorption properties of synthetic resins.* T. B. PANSE, R. C. SHAH AND T. S. WHEELER: *Some new reaction of 1-Benzylidene-coumaran-2-ones. Part I.* JAGANNATH GUPTA AND ANIL KUMAR MAJUMDAR: *Raman spectra of substituted sulphuric acids. Part I.* P. C. MITTER AND PHANINDRA NATH BAGCHI: *Studies in long-chain acids. Part III. On* bis-nor-*Oleic acid.* V. S. PURI AND S. R. SETH: *The effect of colloids on the electrodeposition of nickel on copper.* PARESH CHANDRA DUTTA: *9-Thiophenanthrene and some of its derivatives.* B. N. GHOSH: *On the velocity of hydration and dehydration of nickel sulphate.* PARESH CHANDRA DUTTA AND RAMANI MOHAN SINHA: *Azine derivatives from 9:10-Phenanthrathiophene-2′:3′-dione.* S. N. JOSHI, R. K. KAUSHAL AND S. S. DESHAPANDE: *Structure of oxymethylene methyl ethyl ketone and of oxymethelene methyl-β-phenyl ethyl ketone.* (MISS) ASIMA MOOKERJEE: *The alkaloids of* Rauwolfia canescens, *Linn. Part II.* N. C. SEN-GUPTA AND P. R. SINHA: *On the moving boundary method for the determination of cataphoretic speed of colloids. Part II.* KESHO DASS JAIN AND B. L. VAISH: *Reaction between glucose and iodine in alkaline medium. Effects of neutral salts.* RAFAT HUSAIN SIDDIQUI: *A note on an isomer of dimethylethylpyridine.*

Royal Asiatic Society of Bengal:

January 5, 1942.—FRANKLIN P. METCALF: *Notes on* Cayratia *and* Tetrastigma. The systematic position of the two specimens collected in Hainan in 1921 and 1922 by Prof. McClure which had hitherto been variously interpreted as *Columella Wrayi* (King) Merrill or as *Cayratia papillata* (Hance) Merrill and Chun has been clarified.

A comparison of the available photographs, drawings and merotype show that the species of King, originally described as *Vitis Wrayi* and that of Hance, originally described as *Vitis papillata* are the same and that they both represent species of *Cayratia* and not *Tetrastigma.*

Gagnepain, Merrill and Chun, and more recently Biswas (in litt.) consider this to be a *Cayratia,* not a *Tetrastigma,* though Craib has placed his Siam material under *Tetrastigma.*

The early material from Hainan collected by McClure is something entirely different; it is a species of Tetrastigma, apparently undescribed, and is here proposed as a new species.

SUPPLEMENT TO CURRENT SCIENCE

Vol. XI] INDIAN SCIENCE CONGRESS, BARODA, 1942 [No. 1

Summaries of Addresses of the General President and Presidents of Sections

PRESIDENTIAL ADDRESS

General President: D. N. WADIA, ESQ., M.A., B.SC., F.G.S., F.R.G.S., F.A.S.B.

THE MAKING OF INDIA

THE sub-continent of India consists of two crust-blocks of different nature and constitution, the rigid Archæan shield of Deccan and of the 1,600 miles long folded beds of younger rocks (the Himalayas). Their interaction has produced the third physiographic division of India—the North Indian Plains—built by the alluvial deposits of rivers of the Indo-Gangetic system. These great plains of India cover a trough or depression in front of the earth-waves of the Himalayas passing from Tibet against the immobile crust segment of the Deccan.

The unravelling of the structural features of these three units of earth-body, integrated into one sub-continent, has been India's contribution to the world of science.

In the structure of India, the folded zone has played a comparatively minor part and that also during the last one or two chapters of its history, having but lately emerged from a Central Eurasian sea. This zone bears evidence of great compression whereby the country between Tibet and the Ganges valley has been shortened by 60–80 miles.

The Indo-Gangetic Plain is the newest part to be added to the edifice of India and is still not complete. It has grown almost wholly within the human era by the extension of the flood-plains and deltas of the river systems belonging to the Ganges on the east and to the Indus on the west.

The other structural unit—the Peninsular India—is a non-flexible, obviously impassive block composed of ancient, crystalline rocks which has, since the dawn of Geological history, acted as a peg in the earth's crust. This unit has not attracted so much attention from Geologists as the extrapeninsular region. The old view, that the mountains of Deccan are not true mountains of uplift but are mere relics of an old plateau, is now being gradually given up. Although it is beyond doubt that the segment of India, south of the Aravalli-Hazaribagh line has never been submerged, *en masse*, under the sea since the Cambrian era, or wrinkled into mountain-chains, it bears scars of several periods of earth-movements, though of a kind quite different from the mountain-building movements. Recent geolcgical work carried out by Mr. Wadia in Ceylon has greatly strengthened the new belief. In some respects, the structure of Ceylon furnishes the key to the tectonics of South India.

Ceylon, though an island to-day, is an integral portion of the Carnatic gneissic terrain only recently severed from the mainland, and still connected by Adam's Bridge spanning a shallow strait, only five fathoms deep.

The field Geological work so far carried out in this area indicates, beyond doubt, that the Ceylon mountains are not the undenuded passive remnants left out of an old table land, but have been 'created' by positive earth movements, lifting them vertically in two intermittent, widely separated stages. They are what are known as 'fault mountains' in contrast to the folded, laterally compressed, mountains of the Alps and Himalayan type.

On purely physiographic grounds, Adams made a very suggestive observation in his paper on Geology of Ceylon (1929), that the Deccan plateau represents a continuation of the second peneplain of Ceylon and that the third peneplain of Ceylon might be found in the uplands of the Nilgiris whose highest peaks have approximately the same elevation as the culminating point of Ceylon.

A remarkable parallelism of many of the Ceylon phenomena is detected in the Nilgiri-Palni hills, and their southern extension, the Cardamom hills, which for hundreds of miles have their western, and still more prominently, their south-eastern sides bounded by gigantic precipices. As in the Ceylon mountains, these precipices may not be due to single fractures, but to a system of faults, more or less vertical, in their inclination. They form, in many cases, most striking features of the South Indian landscapes. The Nilgiri-Palni hills and their southern extensions are not the residual stumps of an eroded plateau but are upraised mountains with an orographic axis.

The peninsular India has suffered a series of multiple basin-faulting. The severance of Ceylon from India, the straight and steep contour of the Malabar Coast and the easterly drainage of peninsular India can be traced to this multiple basin-faulting. This type of faulting has given to the Deccan a block-mountain and fault-basin structure. The Indian Peninsula, thus, though still a rigid shield, is not an unbroken unit.

The remaining orography of Peninsular India is represented by the tectonic chains of Aravalli and the Eastern Ghats, all but worn away and now existing mainly in their roots. Once of a size comparable with the Himalayas of to-day, these mountain ranges have played a large part in the succession of geological ages and their detrital waste has furnished the raw material of the principal rock systems of India.

The Vindhya and the Satpura chains, which form the main divide of North and South India to-day, are not of as great geological antiquity. There is some evidence that in the early Eocene they were non-existent and that a northerly drainage flowed across their site to Central Deccan. These prominent lines of steep south-facing cliffs, like the cliffs of the Western Ghats in the Konkan, have been produced, by parallel linear faults, now usurped by the valleys of the Narbada and the Tapti. Though of tectonic origin, these ranges have no axis of folding or compression.

A large section of the Deccan possesses the simplest geological structure possible. This section, covering an area of nearly 200,000 square miles, is built up of flat-reposing sheets of lava, forming a pile from 2,000 to 6,000 feet high, completely burying the ancient geography of the land. Time has sculptured this lava plateau into imposing hills, valleys and plains, but these high hills are only the few outstanding portions of the plateau that have withstood weathering, and have no pretensions to be classed as mountains of elevation. They have no orographic axes of folding, but have remained in their original position and attitude. At the time of its completion, this volcanic formation, known as the Deccan trap, must have covered a much wider extent both in area and altitude, and nearly 400,000 cubic miles of molten rock was poured out from the bowels of the earth during this volcanic period —a volume of rock exceeding both in bulk and mass that represented by the entire body of the Himalayas, and of an average density one-tenth higher than that of the Himalayas.

In the making of India the constructive geological processes have only given the broad outlines of the country; the shape or figure of India, as we see it to-day, is determined essentially by the destructive processes of Nature. The sea, rain, rivers and other atmospheric agencies of change, by their ceaseless action have cut deep into the profile of India and have removed thousands of feet of matter from off the surface producing the existing sculpture of the land.

PHYSICS

President: PROF. B. B. RAY

SOME ASPECTS OF X-RAY INVESTIGATIONS ON SOLIDS, ELECTROLYTIC SOLUTIONS, ALLOTROPES AND COLLOIDS

IN the first part of the address Prof. Ray gives a brief review of the electronic theory of metals outlined by Sommerfeld and modified by Periels, Brillouin, Bloch and others, with special reference to soft X-ray 'emission' and 'absorption' edges in solids. This simple theory neglects the lattice structure altogether and treats the valence electron in a metal as a free electron gas. Mott and Jones have modified the theory by taking into consideration the crystalline lattice field. This modified theory is shown to explain satisfactorily the difference in the structures of 'K' and 'L' emission bands of the elements of the first and second groups, which the simple theory fails to account for. However, many important characteristics of the emission and absorption spectra of solids do not find an adequate explanation on the basis of any of the existing theories. The problem is complicated by the uncertainty of the experimental measure of band-widths, caused by the 'tailing effect' of bands, the presence of 'satellites', the overlapping of the absorption and emission edges, and the superposition of the spectra of elements and their oxides formed on the anti-cathode. Further refinement of the experimental method may be expected to throw fresh light on the electronic theory of solids.

The second part of the address deals with the results of investigations carried out by Dr. Ray on the Debye-Scherrer patterns of the allotropes of sulphur, selenium and tellurium, in the crystalline, amorphous, molten and colloidal states. Many of them hitherto known as amorphous are shown to be crystalline. As is to be expected the diffraction photographs show close resemblance in the liquid and amorphous states. The conditions under which the colloidal sols of these elements are crystalline or amorphous are obtained and a mechanism of coagulation is also suggested. The address also deals with secondary absorption spectra of aqueous solutions of iron and cobalt salts of varying concentrations.

CHEMISTRY

President: DR. M. QURESHI

CERTAIN ASPECTS OF PURE AND APPLIED PHOTOCHEMISTRY

AFTER a brief reference to the relative importance of pure and applied research and the great need for a full co-ordination between the two, certain aspects of pure and applied photo-chemistry have been presented.

Strictly speaking the photo-chemist is concerned only with the chemical changes taking place as a result of interaction between matter

and radiation. A proper understanding of the primary act of light absorption and other physical changes connected with this act is however essential for the correct interpretation of the photo-chemical changes that follow. When radiation acts on an atom, an electron may rise to a higher level or may leave the atom producing ionisation. When radiation acts on a molecule, the several possible primary processes are: (*a*) a change in the rotational state, (*b*) changes in the rotational and vibrational states, (*c*) changes in the electronic, vibrational and rotational states, (*d*) dissociation into atoms immediately on absorption of light, and (*e*) dissociation after a redistribution of the absorbed energy. These primary processes are followed by the secondary processes such as (*a*) fluorescence, (*b*) dissipation of excitation energy by collisions of the second kind, (*c*) transfer of energy to another molecule, and (*d*) chemical reaction. In the case of simple molecules, it is possible to draw definite conclusions about the nature of the primary processes by a study of the absorption spectra. But with complex molecules, definite conclusions can only be reached by combining photo-chemical and spectroscopic investigations.

The quantum yield for the primary process of activation or dissociation is obviously unity. But the over-all quantum yield may vary within wide limits on account of secondary effects. Dissipation of energy as heat or occurrence of a reverse reaction can make the overall quantum yield less than unity; while a chain reaction may lead to values considerably greater than unity.

GEOGRAPHY AND GEODESY

President: MR. GEORGE KURIAN

SOME ASPECTS OF THE REGIONAL GEOGRAPHY OF KERALA

KERALA, the country which lies on the south-western corner of India, cut off from the east coast and the Deccan by the barrier of the Western Ghats, is characterised by a system of backwaters which has exercised considerable influence on the political, commercial, and industrial activities of the country. Beginning with a brief account of the geology of the country, the address proceeds to deal with the climate of this region which is characterised by a striking uniformity of temperature and a fairly abundant rainfall. Then follows an account of the agriculture of the country. The wet lands constitute slightly less than one-third of the total area under occupation, and here rice is practically the only crop cultivated; in the dry and garden lands are grown the perennial crops like coconut, arecanut, jack, mango, cashew-nut, etc., and some root crops like tapioca, yam, and vines like pepper and betel. The question of the density and distribution of the population in Kerala is next considered, and it is shown that a close connection exists between the density of population, the proportion of the cultivable and cultivated lands, and the kind of crops cultivated. Taking note of the rapid rate at which this population is increasing, Mr. Kurian raises the question, "What solution can then be offered for feeding these increasing millions?" A certain amount of industrialisation may "alleviate the suffering, but it may not in itself be able to cure the ailments. Agricultural improvements are certainly called for, and perhaps they are the fundamental sources which are likely to yield results of a more permanent value .... What is actually needed is a new outlook on agricultural enterprise among the governments and the landed aristocracy in the region."

BOTANY

President: N. L. BOR

ECOLOGY: THEORY AND PRACTICE

THE plant geographer has need of a framework of classification of vegetation into which he can fit the facts as he finds them in nature. It is clear that if a system which takes cognisance of ecological concepts be adopted it will be logical and satisfactory. In the past many systems have been formulated which have taken plant form, plant physiology, floristic and so forth as a basis, but none of them have been entirely suitable.

The most modern systems (Clements, Tansley) adopt the dynamic standpoint of the succession of vegetation as their basis. There can be little doubt of the soundness of the basic conception though the conceptions of climax and succession are still in the melting pot. Clements postulates that (1) succession is due to reactions only and is always progressive and (2) that climax is governed by climate alone. This view is adopted by many on logical and philosophical grounds. On the other hand the theory that succession may be forwards, backwards or sideways and that instead of one climax governed by climate there may be several governed by soil, climate or biotic factors, is also accepted by many. Recent discoveries, that podsols are found in low-lying tropical areas and that these bear a vegetation different from that found on adjoining tropical red earths seem to lend some weight to the polyclimax theory.

Whatever may be the ultimate verdict of science upon the theories enunciated above it is clear that the dynamic conception of vegetation is particularly useful when dealing with problems concerning vegetation not yet established, and that, considered as an instrument for the control of the entire range of human uses of vegetation, the conception of succession is unrivalled.

On the other hand the climax is less flexible than the stages of succession. Man can however enrich or impoverish it; it can be destroyed in such a way as to reproduce itself or it can be destroyed so completely as to render its reappearance impossible.

One important fact which emerges from the discussion of climax is that the tropical forest

lives largely upon the products of its own decay. If this be true, and there is little doubt of it, it follows that a luxuriant evergreen forest is no criterion that the soil upon which it is growing is a fertile one. Failure to appreciate this fact has often resulted in forest land being thrown open to cultivation and to its abandonment after a few years when the accumulated fertility due to plant remains alone, had disappeared.

The many problems which arise in India today, due to man's contact with vegetation, such as those connected with forestry, agriculture, grazing, shifting cultivation and so on, must be approached from the ecological angle and dealt with according to the principles of applied ecology.

Erosion, which is causing much concern, at the present time in the Punjab, is due to ascertainable causes and can be prevented by the application of certain principles of plant succession. These and similar problems can be solved by experiment and research based on ecological conceptions.

ZOOLOGY

President: DR. H. SRINIVASA RAO

THE URGENT NEED FOR BIOLOGICAL STATIONS IN INDIA

FIFTEEN out of eighteen universities in India have Biology as a subject for their graduate or post-graduate courses. In the early days the student of Biology in India had to be content with the blackboard and textbook knowledge of this subject. Gradually he has been supplied with preserved specimens and also practical handbooks dealing with Indian types for his study. In recent years good amount of research has been done in India both in Zoology and Botany but mostly confined to the study of structure and classification with the aid of preserved specimens. For nearly seventy years a new complexion has been given to the teaching and research in biological subjects in Europe with the inauguration of Marine and Freshwater Biological Stations. The main purpose of a Biological Station is to provide facilities for the study of animals and plants in their live condition. In India there are no Biological Stations, except the newly started Marine Biological Station of the Travancore State, either on the long stretch of sea coast or on the shores of the numerous vast lakes, although desultory surveys have shown that the wealth of animal and plant life in our rivers, lakes, estuaries, backwaters and seas is infinitely greater than those of temperate climates.

There are immense possibilities of the development of fisheries in India. The bionomics and the life-history of no important Indian fish has yet been worked out, and the European Biologists who are acquainted with Indian conditions rightly attribute the lack of this knowledge to the absence of Biological Stations in India.

The persistence with which the question of establishment of a Marine Biological Station for India has come up during the last ten years before the Indian Science Congress is an indication of the realization by biologists in this country of its importance and urgency. The address pleads for united efforts on the part of biologists, universities, scientific bodies and public men in India to convince the governments concerned of the urgent necessity of establishing Biological stations all over the country and the useful purpose they would serve by promoting knowledge as an instrument of culture and of developing the fisheries with a view to increase the food supply of the country thus giving the masses more nourishment and employment.

ENTOMOLOGY

President: MR. D. MUKERJI

CERTAIN ASPECTS OF MORPHOLOGY OF INSECTS IN RELATION TO HABIT

THE physiological aspect of insect morphology in relation to habit, with special reference to the basic functions of respiration and reproduction, forming the essential subject-matter of the address, is discussed in the case, mainly, of acquatic beetles of the genus Cybister and pulse beetles of the genus Bruchus.

The correlation existing between habit and structure in the larva of Cybister beetle is made clear by a detailed study of the structure of the respiratory mechanism and the natural positions and postures of the larva in the act of feeding and respiring while near the surface of water on submerged weeds, and when below the surface. The special peculiarities in the structure of the lateral and the terminal pairs of abdominal spiracles, are found significant in the light of the functions that devolve on those spiracles. But whether the habit of the larva after it dives under water chasing the prey, to come up to the surface at shorter or longer intervals, is regulated by the oxygen deficiency or excess of carbon-dioxide in the respiratory tubes, must still remain a debatable point. The specialisation in structure and function of the mesothoracic and terminal abdominal spiracle is most marked.

In the larva of the pulse beetle, Bruchus *quadrimaculatus* Fabr. the existence of 4 pairs of large ovalshaped air-bladders connected with the tracheal trunks is most peculiar; they evidently store a large quantity of respiratory air, and should be regarded as adaptive organs to meet the special requirements of respiration in a closed cavity of the seed, in which the larvæ develop into beetles.

By the study of the peculiar structure of the spiracles of the queen termite (*Termes redemanni* Wasm) and the nature and function of the brownish granular substance ejected through the spiracular apertures, the author makes certain interesting suggestions worthy of consideration.

In the case of the function of reproduction, the relation of structure to habit, has been discussed with reference to the reproductory systems and the genitalia of two species of Bruchus, namely, quadrimaculatus and chinensis. The importance of the structure of the genitalia, in the maintenance of physiological or sexual isolation in insects is pointed out; but in the case of the two species of pulse beetles studied, the structure of the genitalia, does not seem to the author to be an effective bar against the interbreeding of the species. If this should be the case, the question whether hybrids are not present among so-called distinct species of Bruchid beetles infesting our stored products, assumes importance and a genetic analysis of the various species and the examination of their genitalia should be undertaken to decide the question.

ANTHROPOLOGY

President: Dr. M. H. Krishna

PREHISTORIC DAKHAN

The address reviews the races of India and proposes a provisional classification based upon recent researches. The history of the various races of India and their immigration to this country is then briefly discussed. The coming of the languages of India in their original form and their sequence is considered. The importance of a study of prehistoric cultures is noted and some of the paleolithic industries of the Dakhan are considered. Then a detailed study is attempted of the light thrown on the prehistory and protohistory of the Dakhan by the excavations at Chandravalli and at Brahmagiri in the Mysore State.

The antiquities of about 2,000 years ago collected at the excavated town of Chandravalli, show that it was the chief city of some local rulers, that it was an industrial town and that it was connected by trade with distant countries including Rome and China.

Brahmagiri in the extreme north of Mysore is a site containing the remains of the town of Isila which was much older than Chandravalli. This site was subjected to trial excavations and revealed the existence of stratified layers reaching back through the prehistoric iron age and the neolithic age to the microlithic age. By a study of the implements and pottery collected in these layers an attempt has been made to prepare a provisional index of the characteristics of antiquities belonging to the various prehistoric and protohistoric periods of the Dakhan, namely the microlithic, the neolithic, the chalcolithic, the iron age, the Mauryan period and the Satavahana period.

Finally the existence of a microlithic period preceding the neolithic is established and the possibility of a short-lived copper age intervening between the neolithic and the iron ages is suggested.

PHYSIOLOGY

President: Prof. B. T. Krishnan

THE NEED FOR THE EXPANSION OF PHYSIOLOGICAL AND PHARMACOLOGICAL RESEARCH IN INDIA

The work carried out so far in the fields of physiology, pharmacology and medicine, in this country, is infinitesimal compared with the vast volume of research work that has been and is being carried out in the Western countries. Ways and means must be devised in various parts of our country for the advancement of medicine in its basic subjects and for turning out greater volume of research work. We are proud of the achievements of our ancestors and the ancient traditions and literature, but we cannot live, progress and compete with the other nations of the world on only traditions and glories of the past. We must progress in scientific thoughts and correlate our ideas of animal physiology with the rapid advances in our knowledge of physics and chemistry and apply the new ideas for the advancement of medicine and pharmacology.

Apart from the general problems in physiology which have an important bearing on the practice of medicine and which still require elucidation by further research, there are several special physiological and allied problems requiring urgent attention and investigation. These are problems of national nutrition, agricultural research, industrial physiology and medicine, physiological standards applicable to India, pharmacological research, with a view to substituting indigenous drugs in place of imported ones and pharmaceutical and biological industry with a view to make the country self-sufficient as regards supply of therapeutic agents, sera, vaccines, etc.

The universities in India should play an important part in the promotion of physiological and pharmacological research. The Government and the universities should afford all facilities for intensive research work in all their institutions teaching chemistry, natural science, physiology, biochemistry, pharmacology, pharmaceutics, bacteriology and medicine by providing well-equipped laboratories and special research assistants and by introducing special diplomas and degrees. Moreover, measures should be adopted for introducing the study of elementary biology, physiology, hygiene and nutrition in the curricula of studies in secondary schools.

MEDICAL AND VETERINARY RESEARCH

President: Dr. C. G. Pandit

IMMUNITY PHENOMENA IN VIRUS DISEASES

Dealing with the present conception of the highly complex problem relating to the mechanism of immunity in virus diseases, a detailed survey of the experimental evidence having a direct bearing on some aspects of this very important phenomena was made.

While the viruses in general exhibited an intimate type of parasitism, adequate knowledge of the vital processes involved when a virus invaded the susceptible cells was lacking. This is also true of other infections. It would appear that the defence mechanism of the infected host is the same whether the infective agent is a bacterium, a virus, or a protozoal organism. Agglutinins, precipitins and neutralizing anti-bodies are produced exactly as in bacterial diseases. If the virus is introduced in the fluids of the host, these anti-bodies are produced and the virus destroyed. The only difference, however, is in the action of the neutralizing anti-body. It is assumed that when the virus is in the body fluids, it unites with the anti-body and becomes susceptible to phagocytosis in much the same way as in bacterial infections. But once the virus enters the susceptible cell, the anti-body has no direct action on the virus. When such a cell divides, the virus will pass into daughter cells and as long as the process is kept up, it will maintain a latent infection or persistence of infection. If the cell is destroyed, the virus will be brought into contact with the anti-body in the surrounding fluid and will then be destroyed. More anti-body is also produced in this way. In case of neurotropic viruses, the virus can also make its way from cell to cell along the connected cytoplasmic processes and ultimately reach its central termination. During its sojourn, it will not come into contact with the anti-body at all, thus explaining the failure of specific immune sera in such infections as poliomyelitis. To this knowledge of the mechanism of immunity following infection, reference is made to Jungeblut's recent hypothesis drawing attention to another defence mechanism which is dependent on environmental factors such as heredity, sex, locality, etc.

Discussing the methods of application of the knowledge so gained in the prevention of virus diseases in man, attention is drawn to the relative merits and demerits, following the use of heat killed vaccines, formalinized vaccines, serum inactivated virus vaccines and attenuated vaccines in the prophylaxis of several diseases.

P. M. N.

AGRICULTURE

President: Dr. Nazir Ahmed

SOME TEXTILE FIBRES OF INDIA

The textile fibres dealt with in the address are only the three fibres, *viz.*, cotton, jute and coir. As may be expected from the kind of work in which Dr. Nazir Ahmed has specialised, cotton occupies the first place and takes up the bulk of the address. As far as we are aware the various fibres of India have never received in any comprehensive manner any critical attention at the hands of the Presidents of the Indian Science Congress and for this reason we should much have desired that the other fibres too had been dealt with. Dr. Ahmed has, moreover, made a slight departure from usual practice by devoting considerable attention to the industrial and commercial aspects of these fibres as they may affect the production and profits of the cultivation as well as the larger and more far-reaching industrial possibilities and the general prosperity of the country. We welcome this special feature. In regard to cotton a general survey is made of the different problems in the cultivation of cotton which have been studied in the different provinces and the success achieved therein. An intensification of the efforts to popularise the results of all this work, generally with a larger measure of financial help from the Provinces and along well recognised methods of extension work, is called for and a strong plea is put in therefor. Though cultivation methods, irrigation, manuring, the baffling diseases, physiological and other conditions leading to crop failures, cotton wilt, boll and leaf-shedding, insect pests like the stem borers and boll weevils have all received attention, the bulk of the work everywhere has of course related to the introduction or evolving of superior varieties or strains, especially of those with longer or better staple. The Panjaub-American cottons, Sind Sea Islands, the Madras Cambodias, the improved Verums of the C.P., the Jubilee of the Panjaub, the Jayavant of Dharwar and other improved cottons are all touched upon in this connection. The disappointing fact that a high yield per acre does not go hand-in-hand with an improvement in staple length is referred to. We would rather stress this point as it is now claimed that judged by the money return per acre, the older strains score over the improved introductions. Dr. Ahmed calculates that in normal years India has to import about half a million bales of long staple cotton, but this cannot be produced locally unless it is made profitable to grow it. Further research alone can solve the problem. India on the other hand suffers from a big surplus of short staple cotton. Measures to expand Indian consumption of Indian mill-goods, a study for stimulating markets for Indian goods abroad, and the diverting of part of the output to other industrial purposes, of which a long list is given, are the remedies suggested.

In regard to jute, reference is made to the higher yielding varieties already made available and the need for research in retting methods, on the ultimate fibre characters of jute, for experiments in the spinning of finer counts of the yarn and the manufacture of the finer kinds of goods, so as to widen the uses to which jute can be put, is emphasised. The bleaching and softening and dying of the jute fibre, adapting it for waterproofing and rot-proofing are also desirable lines of research work.

In regard to coir, the lack of uniformity in the material as prepared now is pointed out and further work on the various aspects of retting is suggested. Work likewise is desirable especially with a view to improve the colour and quality of the fibre and to reduce the period of time now found necessary for the process. Alternative methods especially for preparing good fibre from the husks of ripe nuts, work on the softening, bleaching and dying as well as on making union fabrics with

other fibres are all indicated as important and promising lines of work. In respect of all the fibres dealt with the manufacturing side is emphasised so as to secure a wider utilisation and a larger market for the products.

A. K. Y.

ENGINEERING

President: DR. ANANT H. PANDYA

EDUCATION FOR THE ENGINEERING INDUSTRY

IN his Presidential Address, Dr. Pandya has laid stress on the great and urgent need for the proper training of skilled personnel, a fundamental and vital aspect of industrial development. In spite of numerous technical institutions in India, he remarks, suitable and sufficient training for industries is scanty.

A few experimental technical schools have been started in Bombay and Hyderabad, as a result of Messrs. Abbott and Wood's report on "Vocational Education in India", published in 1937. Also a polytechnic has been opened at Delhi early in 1941. On the 28th July 1941, an Association of Principals of Technical Institutions (India) was formed with a view to co-ordinate the efforts of all Provincial Governments and private bodies and foster all-round co-operation between educational interests, industry and professional bodies.

The conduct of modern industry demands, as Mr. Abbott observes, "the services of men who have had a broad general education, on which they have built a first-rate scientific education". But for university men trained in scientific method, he points out, there would have been a serious dearth of men qualified to carry on research. In the United States, a number of curricula fairly similar is provided so as to enable students to transfer from one curriculum to another at the end of any term during that period, thus affording a freedom of choice among special fields. Humanistic and social subjects including the arts of expression (spoken and written) form part of an engineer's course and the introduction of these subjects in the syllabuses of our institutions, observes Dr. Pandya, deserves very careful consideration.

Research as an instrument of engineering education has not been fully recognised in India. In Great Britain and the United States, it has been accepted as a tenet that research can be used very effectively in the higher classes. Dr. J. C. Jackson observes that competent engineering is a research occupation. Dr. Pandya observes that in India, insufficiency of staff and financial resources of institutions, lack of co-operation between industry and educational institutions and overcrowding of undergraduate syllabuses hamper research. Institution of post-graduate courses which would include research and advanced professional subjects and permitting senior members of staff to have a certain amount of consulting practice, as in medicine, law and architecture would to some extent remedy this unhealthy defect. In India, recently a Board of Scientific and Industrial Research has been established and if the work is to develop rapidly on wholesome lines it is imperative that the training of research workers should be undertaken in a close co-operation with science and engineering colleges.

Industries and commerce must co-operate with technical educational organisations. Abroad, a noteworthy trend in higher technical education is the provision of co-operative courses between the college and works, enabling students to spend part of their time in college and a part in works. Most of the colleges in India, at present experience great difficulty in arranging even for post-graduate practical training of their students. Without a conscious demand from industry and without a close, regular and full co-operation of industry and commerce, technical education cannot progress. Many firms in Europe and America appoint special officers to supervise the practical training of students and Dr. Pandya suggests that our firms will do well "to extend their co-operation in this direction with immediate benefit to every one concerned".

We are at present on the threshold of a new era of industrial expansion. To enable our industries to develop without avoidable delay, it is imperative to bridge the gulf between industry and education and in the measure we are able to span this barrier, we will achieve that essential high technical efficiency, by the continual technical development of our industrial worker.

C. GOPALAKRISNA.

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SOME FACTORS IN FOOD SUPPLY

IT was probably in one of the lectures of the genial Roscoe in Manchester that the present writer heard the story of Faraday and the untidy laboratory bench. It was related that a somewhat fussy old gentleman, on visiting the laboratory, rather pointedly drew Faraday's attention to a bent tube lying on the bench, containing a little yellow oil. "You should not leave oily tubes about on the bench like this," he said. Faraday made no remark, but the next day the old gentleman received a short note to the effect: "Dear Sir, the oil which you saw was liquid chlorine!"

To the writer it has always seemed that this incident records one of the most epoch-making among the great series of discoveries associated with the name of Faraday. Its importance lies not so much in the liquefying of chlorine, although at the present time tons of this liquid gas are used to sterilise the water supplies of great cities, but of more importance was the method used in bringing about liquefaction of this and other gases which meant a fundamental extension of the means available for the lowering of temperature. The greater number of modern refrigerating plants involve the alternate evaporation and recompression of either liquid ammonia or sulphur dioxide. This has rendered possible food storage on a large scale, with the consequent increase of facilities of travel and the transport of

perishable food over great distances. It has added greatly to the amenities of life in tropical countries and in the latest development known as "air conditioning" has actually altered the climate of whole buildings.

In consequence of the possibilities thus raised there has been great increase in the scientific knowledge of food storage and preparation, and the subject of dietetics has become of public interest; while large questions of agricultural and economic policy have come under consideration.

In the following paragraphs the attempt is made briefly to deal with some of the more interesting features of these topics.

Cold Storage. The problems concerned with the cold storage of differing types of food have involved a great deal of scientific research on various lines. Thus the proper storage of **meat** has meant the investigation separately of the effect of such storage on the proteins and fats of the various descriptions of flesh concerned. Careful control of moisture loss must be exercised. Possible bacterial infection has been prevented by the application of ultra-violet rays. The relation of the method of killing towards keeping quality has been found of importance, whether, *e.g.*, pigs are killed on the farm, or later in the factory.

The application of cold storage to the increased supply of **fish food** is of somewhat special interest. The newest method of refrigeration involves the production of ice in very small particles so that the flesh of the fish is not injured thereby in the subsequent processes of preservation and canning. As a result of improved methods of freezing, filleting and canning it has been possible to make use of 150 different kinds of fish instead of the former staples of cod and herring. The waste products are utilized, the skins and scales converted into fish glue and other refuse into fertilizer or cat food.

The cold storage of **fruit**, in addition to the improvement in bactericidal methods for the control, *e.g.*, of moulds on oranges, has involved a profound study of the "breathing" of certain fruits, particularly apples, pears and bananas, and the effect of varying proportions of gases such as carbon dioxide, or ethylene in the storage atmosphere, on the quality of the fruit on delivery.

Apart from the cold storage industry, arising directly from the investigations of Faraday, there are many other paths of research and industry accessory to this primary development. The **canning industry** has involved investigations in many directions, *e.g.*, the exceedingly troublesome subject of corrosion, and the possible contamination of the food with elements from the metallic containers. The lacquering of tins has affected the lac and resin industries.

Food Production. The foregoing factors are concerned, it will be seen, mainly with the preparation of food. Its production, since all food ultimately is derived from the soil, must depend on the workers in agriculture in all its multifarious branches. The work of the **plant breeder**, according to a recent article in the contemporary *Science and Culture*, has had enormous influence on the food supply of the world and particularly of India. The two staples of wheat and sugar have only to be mentioned. New possibilities of food plants also are under attention notably the soya

bean, concerning the dietetic value of which there seems to be some difference of opinion amongst responsible authorities.

The question of the relation between the method of cultivation of crops and their resulting quality, as well as of the kinds of food best suited to promote adequate nutrition, has furnished material for intensive discussion and considerable literary output. Thus a group of Cheshire doctors who have been in touch with 600 family doctors have published a medical testament in which they contend that health must be won by proper feeding and general use of fresh fruit grown on fertile soil. They therefore urge the necessity to maintain the fertility of the soil.

At a meeting at Crewe, Cheshire, at which the Lord Lt. Brigadier-Gen. Sir William Bromely Davenport took the chair and Major-Gen. Sir Robert McCarrison and Sir Albert Howard and others took part, Sir Robert and others pointed to four faults in existing nutrition. They are:

1. The use of denatured wheat flour.
2. Excessive consumption of carbohydrate food specially sugar.
3. Insufficient use of fresh green vegetables and salads.
4. Insufficient use of safe milk.

Though meat was not harmful too much was eaten.

In an important volume entitled: *British Agriculture* by Astor and Rowntree they state that the key is the marriage of agriculture and nutrition. They advise raising milk and importing wheat and beef. They think that 2½ million more cows are needed. Dairy lands and dairy herds must be improved. They do not however recommend self-sufficiency but think that the nation should hoard imported food stuffs and increase the productivity of the soil. The State, they contend, should be largely an agricultural landlord.

In a volume entitled: *Feeding the People in War-time*, by Sir John Orr and David Lubbock, they recommend more milk, more oat meal, and more vegetables, especially potatoes. They would cut out meat, eggs, sugar and bacon and compensate by cheese and dried fruits and fats. Weight for weight they state cheese contains twice as much nourishment as beef. The ideal war-time meal is porridge or cereals, margarined toast, perhaps sausage, potato, cheese and vegetables.

These normal physiological and dietetic complexities are not decreased when it is remembered that what may be scientifically excellent from the point of view of the nutrition experts may not be attractive to the appetite of the ordinary citizen. After all the psychological factor cannot be ignored.

The question of fertilizers at the present time is receiving special attention, particularly perhaps in England. The relative merits of mineral fertilizers generally summarised as N, P, K in comparison with organic materials is a subject of wide discussion. This is so much the case that quite recently a ten-year experiment has been initiated to arrive at some conclusion on this matter. The work is being undertaken under the inspiration of Lady Eve B. Balfour, the experimental area being located at the Haughley Research Farms in Suffolk, England.

The need for increased supply of high quality food has also led to an intensive study of the recovery and preparation of

organic refuse as fertilizer. A statistical survey has shown that the total quantity of vegetable and putrescible refuse available for Great Britain comes to about one million tons or some 13 per cent. of the total refuse, organic and other. This refuse together with the bugbear of the sewage works, *i.e.*, sludge of various types, has virtually started a new industry of fertilizer production. Thus at Kensington after hand-picking on moving belts the refuse is crushed, sprayed with an inoculant and fermented ærobically and anærobically, the resulting product being a coarse brown powder containing 30 per cent. of organic matter, 1 per cent. nitrogen, 40 per cent. inorganic solids and 30 per cent. of moisture, the product being termed "Hyganic". At other centres notably Maidenhead and Leatherhead ordinary sewage sludge and dry town's refuse are fermented together after suitable preliminary mechanical removal of metallic and other useful items. The heat of fermentation it is stated drives off the greater portion of the sludge moisture. In this way two troublesome waste products are made into a useful fertilizer, and from a personal communication to the writer it is learnt that this is always oversold to the farmers.

This modern fertilizer is naturally somewhat bulky and consequently the question of transport becomes of particular importance and may lead to the renewed utilization of the old canal system of England which had largely fallen into disuse through competition with the railways. Canal transport however has many advantages and might, one would think, be easily developed in India through the expansion of the irrigation canals, as well as the more efficient use of such waterways as the Buckingham Canal in the Madras Presidency.

An interesting proposal for modernising canal transport has been put forward by Mr. J. A. Coombs before the Institution of Sanitary Engineers. Mr. Coombs proposes to use a special type of conveyor which can be floated on the canal and transferred to wheels for land transit, propulsion being effected on the lines of the electric tram.

At the same time as this virtually new industry of fertilizer production is developing, 100 workers at Rothamsted are investigating numerous detailed problems of plant production by means of pot culture. One of the most notable observations is the remarkable effect of boron and also of other trace elements.

What is known as the "Dig for Victory" campaign in England has resulted in the creation of 2,000 Allotment Societies in Great Britain with a membership of 200,000. An average allotment measures 10×30 yards, *i.e.*, 1/16th of an acre, and can keep a man, his wife and his three children on potatoes and vegetables for 212 days out of 365.

Apart from the good food thus raised there can be little doubt that the physical exercise involved in the actual tilling of the soil, and the mental interest and relief in taking part in the growing of living things, must have a very beneficial effect on health and morale.

In addition to allotments the question of Hydroponics is naturally receiving attention. There appear to be two systems of soil-less culture, *viz.*, a water tank with suspended trays, and sand beds with circulated solutions of nutrient salts. From

interesting results recently obtained in connection with the small Activated Sludge installation at the Indian Institute of Science, Bangalore, it would appear likely that the question of humus may arise here also, as in the case of ordinary agriculture. It may be that the great Activated Sludge tanks at West-Middlesex and elsewhere may be made into "hanging gardens" on which tomatoes and other suitable vegetables can be grown in war-time, and tulips or roses in days of peace. It is quite possible that the hydroponics tank may be found side by side with the compost heap in a normal garden, the necessary aeration being produced by an electrically driven paddle wheel.

The Economic Factor

When it is realized what a vast field of study and scientific research has been explored in the endeavour to improve the quality and quantity of the peoples' food, it is indeed sad to read Sir John Orr's statement that 4½ millions of the population of England spend no more than 4 shillings per week per head on food. This expense he says should be doubled. It is when we come to consider this reverse of the picture, that other factors are seen to enter into the question of food supply. In the early days of the Industrial Revolution in England cheap food and consequent cheap labour was one of the main objectives of the industrial employers. The ultimate result of the concentration on this objective has been the development of mechanical industry at the expense of agriculture. This has meant the destruction in large measure of agricultural land both in Britain and elsewhere. Thus the virgin soil of the vast areas of the Western States of America was ruthlessly exploited and eventually the humus capital became exhausted so that we have the tragedy of the "dust bowls", humorously indicated by one former landlord in his expression: "My uncle will be along soon, I just saw his farm go by." In South Africa the lure of comparatively useless gold and diamonds has led to the neglect of the true wealth of the country. In India we learn from Dr. Maclagan Gorrie how increasing areas have been sacrificed to ill-nourished cattle and goats. Continually it seems to be forgotten that the land must always be recompensed for everything that is taken from it, if final disaster and food bankruptcy are to be avoided.

Ultimately the root cause of all this other side of the picture is cheapness which has been defined by a responsible Indian State official as "the curse of India". It is to be feared that India is not alone under this curse. The main reason why so great a proportion of the population, not only of England but also of India and many other countries, suffer from malnutrition is that in spite of all the scientific research and of the vast possibilities of food supply which exist under present conditions these unfortunate people are unable to pay for the food which is so needful for them.

Considering further the cause of this we find it to be largely the result of a defective monetary system, and the dominance of the Profit motive. The greater the possible supply of good food the less would be the possibilities of money profit. When therefore money is valued before men we have the dreadful phenomena of food desctruction, where fish is thrown back into the sea, coffee is burnt as fuel in

locomotives, and farmers are paid not to raise hogs. Other consequences also arise owing to the dominance of vested interests particularly, *e.g.*, the non-supply of whole meal bread, partly because of the difficulty of storing whole wheat flour. The most nutritious portion of the flour has thus to be first removed. A curious illustration of this trouble is given incidentally in a recent letter from England wherein the correspondent speaks of considering the possibility of installing a small hand-mill in her flat in order to obtain sound flour for her bread. The implication raised here concerning Mr. Gandhi's Village policy does not need elaboration.

What then is to be the solution of the grave tragedy of deficient or imperfect food, and of malnutrition? It is evident that in the "New Order" men will have to be considered before money. Recently every member of the British Parliament has been furnished with a copy of a small book by Sir Reginald Rowe entitled: "The Root of All Evil". It is not, as so often misquoted, that money is the root of all evil, but the love of money in itself does indeed fulfil this definition. Money in itself is merely a catalyst accelerating changes which would otherwise take place slowly if at all. The fundamental mistake has been to consider money as itself a commodity to be dealt in like ordinary goods and services. This concept of money apparently has the power of vitiating the whole area of financial thinking, creating the absurdity, *e.g.*, of considering a "favourable balance of trade" as being an advantage when what it ultimately means is that we are giving away our goods to our neighbours for nothing. It has been stated that "to financial experts and bankers, money is merely a hen for laying eggs of interest". An increasing body of opinion is coming definitely to the conclusion that money must no longer be looked upon as a commodity, but that it must be issued by the State in amount exactly to balance the requirements of the consumer. The consumer, in fact, must be subsidised rather than the producer. Otherwise the consumer starves at the profit of the farmer. With the proper adjustment of money counters both would be benefited. Already free milk is supplied to necessitous school children and proposals have been made for free food for everybody. According to this proposal there should be a World Food Council of all the nations of the world, and every nation should have its own food council. Through these national councils the general World Council should learn how much food is available from every nation and how much is needed by every nation. The World Council would effect an equitable distribution of the available food products, but as food can now be produced almost illimitably there should not be any shortage for any nation. There should be everywhere State-owned and State-run distributing centres through which the ordinary man who could not afford to pay or has less than a certain income could obtain free food, just as education is supplied free to all who require it. Free food is indeed part of the Russian programme.

In the United States some progress has been made in the provision of food for all through the intervention of what has come to be known as "Surplus Sal". The idea appears to be to allow people to spend some of their relief money in yellow stamps

which they can use at certain registered shops to buy food. Along with the purchased yellow stamps, they are freely given one blue stamp which is good for a food product which comes under the head of surplus. Thus there need to be no waste of crops of any sort and at the same time no serious dislocation of ordinary business operations.

In ways like this, and with the vast experience which war-rationing has furnished the Government, we may hope that the worst blot on our so-called civilization may, in part at least, be wiped out. In this as in other hoped-for features of the "New Order" it is not cheapness which must be relied upon, but rather, as the Editor of the *Economist* is reported emphatically to have remarked, "Brains."!

GILBERT J. FOWLER.

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SIR CATTAMANCHI RAMALINGA REDDY, Kt., M.A. (Cantab.), Hon. D.Litt. (Andhra), M.L.C.

THE happy news that Sir C. R. Reddy, M.A. (Cantab.), D.Litt. (Andhra), M.L.C., Vice-Chancellor, Andhra University, is amongst the recipients of Knighthood, will be received with gratification by a wide circle of his pupils, friends and admirers throughout India. Sir Cattamanchi is one of our foremost educationists who has played a conspicuous part in shaping the educational policy of this country. His "Memorandum on Education in Mysore" which was published in the year 1919 constitutes one of the epoch-making documents which continues to inspire and influence the progress of education in Mysore.

As Vice-Chancellor of the Andhra University, he has been exceptionally successful in stimulating private munificence through which several Chairs and Lecturerships have been founded in the University. Soon after the declaration of the present war, Sir Cattamanchi pleaded for an immediate orientation of the work of the University laboratories to meet the war economy of the nation. He referred to the situation which arose 25 years ago and pointed out how the European countries and America grasped the opportunity at the time to achieve a state of self-sufficiency. He said "by confiscating enemy patents, by vigorously promoting domestic industries in regard to dyes, drugs, etc., and utilising universities for purposes of the necessary researches, European countries and America became self-sufficient."

In 1930, he resigned the Vice-Chancellorship of the Andhra University as a protest against the repressive policy of the Government during the days of the Civil Disobedience movement.

By conferring upon him the Knighthood, His Majesty's Government have honoured a distinguished educationist, an accomplished scholar, a practical statesman and above all, an esteemed patriot. We extend our hearty and respectful felicitations to him on this occasion.

THE PHENOMENA OF CONICAL REFRACTION

BY

SIR C. V. RAMAN

THE newly developed techniques for growing large transparent crystals by slow solidification from melts are of great value for those interested in optical investigations with such crystals. In two recent communications,[1, 2] attention was drawn to the very striking demonstrations of conical refraction possible with crystals of aromatic organic compounds. A transparent block of naphthalene, a centimetre square and half a centimetre thick, prepared by Mr. T. M. K. Nedungadi and mounted between parallel glass plates has enabled me to pursue the subject further and make some observations which appear well worthy of being placed on record.

As mentioned in the earlier communications, the angles of internal and external conical refraction are both large in naphthalene, so much so that conical refraction can be shown in the same way as ordinary birefringence, *viz.*, by viewing a line of print through the crystal block. Figs. 1 (*a*) and (*b*) illustrate the effects observed in this way. It will be seen that a dot in print appears as a circle, and a circle as two concentric rings, when seen through the crystal at the correct orientation.

Several years ago, I noticed and described a very remarkable optical effect[3] associated with conical refraction which is observed when a small luminous object faces a parallel plate of aragonite suitably orientated and held at some little distance from it. A bright erect image of the luminous object superposed on a field of general illumination may then be seen anywhere on a line behind the crystal which is a prolongation of its join with the object. The same effect is shown in a much more striking way by a naphthalene block. Not only is the image seen much more intense than with aragonite, but it can also be traced to much greater distances, indeed up to about a metre, and is visible even when the luminous object is similarly far removed from the crystal. The effect is illustrated by Fig. 2(*a*) which is a human profile scratched with a needle on a glass plate covered by black varnish and placed in front of the naphthalene plate, while Fig. 2(*b*) reproduces the image of the same received on a photographic plate placed behind the crystal. It will be noticed that the features of the profile are recognizable in the image, though slightly distorted owing to the optical imperfections of the crystal. The images formed in this way by the crystal plate shows a strong chromatic dispersion, and it is therefore necessary to use monochromatic light (the green rays of the mercury lamp) in photographing the effect.

An explanation of this remarkable property of biaxial crystals was given by me in 1922.[4] This is completely confirmed by the present experiments which show that the phenomenon is of fundamental significance in relation to the physical theory of conical refraction. The image-formation in the rear of the crystal arises from the intense concentration of luminosity which occurs at the singular or conical point on the wave-surface within the crystal. This is shown by the fact that the image is most intense at the rear surface of the crystal where the waves emerge from the crystal at the terminus of the axis of single ray velocity (Fig. 8). Using a point source of light and covering up the illumination in the field behind the crystal except for a small aperture at the position of the image, the light is found to diverge from the bright spot in the form of a hollow cone. When both the source and the aperture are situate on the faces of the crystal, this is identical with the Hamilton-Lloyd experiment demonstrating external conical refraction.

In the usual discussions of conical refraction, the geometric aspects of the problem receive attention, while the closely related physical aspects are practically ignored, though the latter are as interesting and important as the former. Corresponding to the two geometric properties of the ray-surface discovered by Hamilton, we

1 *Nature*, 1941, **147**, 268.

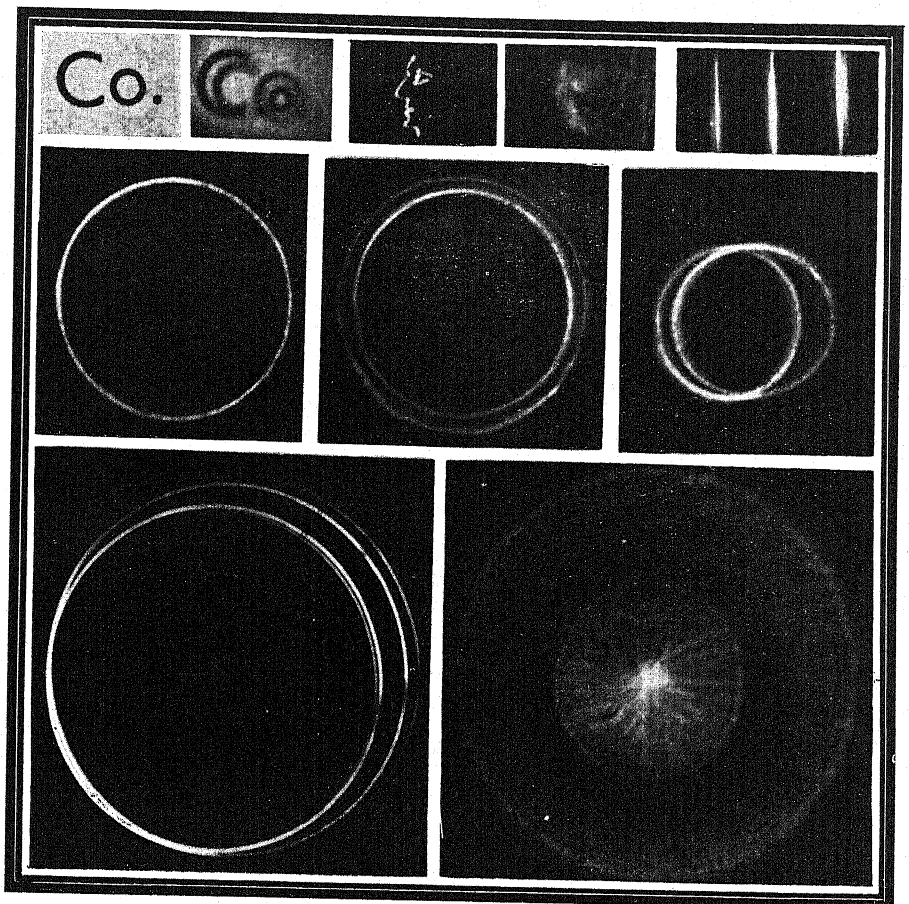
2 *Proc. Ind. Acad. Sci.*, 1941, **14**, 221.

3 *Nature*, 1921, **107**, 747.

4 *Phil. Mag.*, 1922, **43**, 510.

FIG. 1 (a)   (b)   FIG. 2 (a)   (b)   FIG. 3

FIG. 4



FIGS. 5 & 6

FIG. 7   FIG. 8

Illustrating Conical Refraction in Biaxial Crystals

have two physical properties, namely the intense concentration of intensity at the singular or conical point and the vanishing of the intensity along the circle of contact of the tangent plane with the ray-surface. Both the bright spot and the dark circle surrounding it may be traced to a considerable distance behind the crystal using a point-source of light and a low-power magnifier.

The phenomena exhibited by a naphthalene crystal in certain respects present an exceptional simplicity. The image of a fine pin-hole illuminated by monochromatic light and viewed in perfect focus through the crystal appears as a single sharply defined circle (Fig. 4), the so-called Poggendorf dark circle being then non-existent. Fig. 5 shows the ultra-focal image where the two circles are just separated, and Fig. 8 the case when the microscope is focussed on the second surface of the crystal, the bright spot at the centre being then conspicuous. Fig. 6 is the appearance of a fine illuminated pin-hole seen through a fairly thick plate of aragonite at as near a perfect focus as possible. It will be seen that we have now not a single circle, but two *intersecting* curves, one of which notably departs in shape from circularity. This feature is a general one shown by all biaxial crystals of which the angles of internal and external conical refraction differ sensibly, the coincidence of

the two curves in naphthalene being a special feature due to the identity of the two angles.

Figs. 3 and 7 illustrate the dispersion of conical refraction as observed with a naphthalene crystal in two different ways. In the former, a straight slit illuminated by the total light of a mercury lamp is employed as the source, and the crystal itself forms the spectral images of the source as already explained. In Fig. 7, on the other hand, a fine pin-hole is employed as the source (as in Fig. 4 but with a thicker plate) and is viewed in exact focus. Four distinct circles are then seen corresponding to the four brightest rays of the mercury lamp.

The photographs illustrating this article were obtained for me by Mr. V. S. Rajagopalan.

THE NEW CHARTER OF SCIENTIFIC FELLOWSHIP

DECLARATION OF SCIENTIFIC PRINCIPLES

A CONFERENCE on Science and World Order was organised by the British Association for the Advancement of Science, during September 1941. The Conference was held at the Royal Institution and its deliberations covered the relations of science to government, human needs, world planning, technological advances, post-war relief and world mind. At the end of the conference, Sir Richard Gregory, Bart, F.R.S., President of the Association, presented the Charter of Scientific Fellowship.

The text of the declaration of Scientific Principles is reproduced here.

1. Liberty to learn, opportunity to teach and power to understand are necessary for the extension of knowledge, and we, as men of science, maintain that they cannot be sacrificed without degradation to human life.

2. Communities depend for their existence, their survival and advancement, on knowledge, of themselves and of the properties of things in the world around them.

3. All nations and all classes of society have contributed to the knowledge and utilization of natural resources, and to the understanding of the influence they exercise on human development.

4. The basic principles of science rely on independence combined with co-operation, and are influenced by the progressive needs of humanity.

5. Men of science are among the trustees of each generation's inheritance of natural knowledge. They are bound, therefore, to foster and increase that heritage by faithful guardianship and service to high ideals.

6. All groups of scientific workers are united in the fellowship of the Commonwealth of Science, which has the world for its province and the discovery of truth as its highest aim.

7. The pursuit of scientific inquiry demands complete intellectual freedom and unrestricted international exchange of knowledge; and it can only flourish through the unfettered development of civilized life.

—(*Nature*, 1941, 148, 393.)

THE MANUFACTURE OF SYNTHETIC DRUGS AND FINE CHEMICALS*

BY

K. VENKATARAMAN

(Department of Chemical Technology, The University, Bombay)

RECENT articles in some of the daily papers might have given the impression that there has been a phenomenal advance in the matter of drugs and fine chemicals, and that scores of these are now being manufactured in the country. Names and quantities are usually not mentioned, and one has merely to make enquiries for some of the commonest medicinal chemicals from the trade to realise that no undue optimism would be justified. There has undoubtedly been much progress in the production of tinctures, extracts, galenicals, etc., but little or none in the manufacture of synthetic medicinal and allied chemicals, the variety and scope of which can be gauged from the Directory of the Association of British Chemical Manufacturers, which contains over 4,000 items, including synthetic drugs, disinfectants, anæsthetics, analytical reagents, and photographic chemicals. It is probable that, among the necessarily narrow range of chemicals required for the army, which must take precedence at the present time, many are being made. For essential war requirements, price and other factors normally governing the production of commodities would be minor considerations, but if a real synthetic drug industry is to develop, one has to examine carefully the foundations on which it is built and the chances it has of survival after the war. The few medicinal chemicals we are producing—ether, chloroform, chloral hydrate, ethyl chloride, etc.,—are in inadequate quantities and at more or less noncompetitive prices; or in the alternative, as in the case of sulphanilamide, the synthesis has been based on imported chemicals—aniline,

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* A symposium on this subject was opened by the writer at the Baroda Session of the Indian Science Congress on the 5th January 1942. In the October issue of the *Journal of the Society of Dyers and Colourists* (**1941, 57, 305**), just come to hand, Bruce has presented an elaborate account of "Vital developments from the dyestuff industry" in which he has clearly demonstrated its fundamental importance as a key industry. On account of its striking application to our own problems, an extract will be of interest.

"It surely is apparent now that any nation which, for the maintenance of its population, has to keep its position as an industrial power, must, for its continued existence, maintain and control supply and be self-sufficient for every vital manufacture. .... Industrial development has been so rapid and technical advance so prolific and important that, to-day, a nation might be rendered completely powerless in an international struggle because of the lack of some vital manufacture, apart from weapons, even while her rulers and general body of her industrialists were unaware of the product's existence. .... Arising from the dye industry as a basis, almost any organic substance can, if necessary, be made in great quantities. .... It is this wider aspect of the subject which must be appreciated to envisage the developments possible from dyes as a basis, for it is undoubtedly on that foundation that the enormous edifice of the synthetic chemical industry has been built. .... The most important of these facts is that this country is largely dependent in almost all its present-day industries on synthetic organic products. Their key importance is such that the country's strength in this field must be a measure of its greatness as an industrial country. .... Again, those countries exploiting the synthetic organic chemical industry with energy gain a lead and an advantage transcending that of geographical position and even of many rich natural resources, if these are not also industrially exploited, because high quality manufacture gives greater return for effort, needs skilled labour and altogether means greater prosperity than abundance of raw material and agricultural produce can bring. Another fact that emerges is that the most important organic chemical industries are fundamentally dependent on coal, lime, salt (with water and air), *i.e.*, raw materials within easy reach. .... The national failing in buying for immediate expedience, in place of making for permanent assurance of supply, is surely a bitter regret to-day. We have always too readily assumed that we could not compete with certain manufacturers without making the attempt. .... A most important fact is that the manufacture of synthetic organic products has already developed at a much greater rate than any other established industrial activity and appears to have still greater potentialities of further increase than any other class of manufacture."

acetic acid, chlorsulphonic acid, etc.—which may no longer be available. The writer was at one time associated with a factory manufacturing aspirin from imported salicylic acid and acetic anhydride, and when a rise in price of the latter removed the small margin of profit the project had to be abandoned, the manufacture of acetic anhydride being outside the programme and beyond the resources of the firm concerned. The first and most urgent problem, therefore, is the manufacture of the essential inorganic and organic raw materials, intermediates and solvents; since many of the newer pharmaceuticals are based on coal tar products, this would be contingent on the development of a dye industry, for which more or less the same basic chemicals would be required on such a scale that their economic preparation, at prices comparable with those prevailing in Europe and America in normal times, would become inevitable. Bayer, Ciba, and Sandoz have had their success as producers of synthetic drugs on account of their being primarily dye manufacturers. Apart from many dyes themselves, which are used as antiseptics, biological stains, etc., the range of medicinal chemicals derived from coal tar hydrocarbons and dye intermediates is too numerous to be listed and a few common examples must suffice, such as phenol, resorcinol, sodium salicylate, aspirin, benzoic acid, saccharin, sulphanilamide, sulphathiazole, salvarsan and other arsenicals, atebrin and stilboestrol. As an instance of the dependence of drug production on the availability of coal tar intermediates and the relevant inorganic heavy chemicals, one might refer to sulphathiazole, the value of which against plague and as a bactericide of wide utility has been demonstrated in the Haffkine Institute; it is in great demand and the price of the imported substance is prohibitive. In the absence of the basic chemicals which are unavailable in the country, the production of sulphathiazole on a large scale has been impossible.

It is well known that the difficulty in the manufacture of dyes, excepting perhaps the complicated antraquinonoid vat colours in which unusual condensations requiring prolonged and careful study of the experimental conditions are involved, is not in the final stages of the conversion of intermediates into dyes, but in the manufacture of the intermediates themselves. The fundamental organic raw materials, benzene, toluene, naphthalene and anthracene, and the necessary inorganic chemicals—acids, alkalis, metals and salts of which there are over 80 required—should be produced in adequate quantities, and at prices that would not rule out a given dye or drug right at the start. Two outstanding features of the modern dyestuff industry, which would apply even more forcibly to synthetic drugs, are that raw materials of the utmost purity are employed and the final marketed product should be, if not chemically pure, of a standardised quality in which there is no variation from bulk to bulk. Benzene, for instance, has to conform to a very exacting and rigid specification, but has at the same time to be produced at less than a quarter of the price quoted by the firm which seems to be the only one in India now in a position to produce benzene of the requisite purity. These problems concerning raw materials, as well as those related to the production of the bulk intermediates, such as nitrobenzene, aniline, phenol, resorcinol, β-naphthol, and salicylic acid, can only be solved by the biggest of our tar distilleries and chemical companies with the active and single-minded assistance of Government. The preparation of such intermediates in university laboratories is a very useful exercise for technical chemists or chemical engineers under training, but no more. Many of us have been attempting to utilise whatever facilities we have for the production of a few lbs. of one or other of these. While this has been unavoidable in the present emergency, it has little bearing on the ultimate possibility of their manufacture. These are all chemicals for which the methods of manufacture, the plant and procedures are known. In a country in which the chemical industries are largely undeveloped, Government must take the initiative for ensuring that the establishment and continued progress of such vitally important industries as dyes and drugs are made possible by every assistance for production in the first instance of the essential raw materials and intermediates. The position at the moment is obviously a difficult one, but some attempt must be made to import the necessary plant on the basis of a plan, which would include as many of the inorganic and organic chemicals as possible. The plant is the one obstacle in our way. One cannot go into details in

this note, but it is obvious that, in addition to the very specialised experience that is necessary for their fabrication, particularly of high pressure autoclaves provided with agitators and having to withstand stringent conditions of temperature and corrosion, our engineering firms are handicapped by the lack of the special constructional materials —alloys, stainless steels, facilities for acid-proof and other linings and so on. We cannot afford to wait for these to be made by natural processes of trial, error and evolution; and in the initial stages the plant must be imported, although one realises that in the long run a stable chemical industry must be self-contained for its supply of chemical plant, of which the varied types demanded by modern chemical operations must be fabricated in the country.[1] There is all the difference between the construction of chemical plant and their operation. Many years must elapse before we are in a position to construct the chemical plant required for a full-fledged chemical industry, embracing both heavy chemicals and organic fine chemicals; Great Britain has had to turn to Germany and America for many years, even after the experience of the last War, for certain plant units.[2] We have, however, chemists and chemical engineers sufficient in number and ability to operate plant of the most complicated character. Our cotton industry has existed on imported machinery; it is our premier industry and it occupies a not inconsiderable place in the cotton industry of the world. With a given range and size of plant, production for a long period becomes possible and, during the interval, there is nothing to prevent a determined and organised effort being made to develop plant fabrication.

The expansion and modernisation of our ordnance factories are helpful. After the war, the plant, processes and technical personnel would all be useful for the fine chemical industry.

One aspect of the production of drugs and fine chemicals, which needs attention, is the scale on which production should be undertaken. The manufacture of a chemical in several small factories is usually much less efficient and economical than centralised production. Naturally the question has to be considered in all its bearings, but a much closer scrutiny must be made of what the economic units are in each case. One has only to think of the research that is continually necessary to improve quality and yield, the advantages of setting apart units of equipment for the preparation of a single chemical, and the tremendous spadework that has to be done to inspire confidence in the purity of pharmacologically potent drugs, to be convinced of the need for carefully co-ordinated schemes of production.

A survey of our synthetic drug and fine chemical requirements must be undertaken on the same lines as the survey now in progress regarding dyes. The Chemicals Sub-Committee of the National Planning Committee collected data and prepared reports on these subjects, and it is to be greatly regretted that these reports on many problems of immediate practical importance have perforce gone into cold storage. Whatever organisation might now undertake the work, it is necessary to have accurate data on our requirements of the major synthetic drugs as early as possible. The survey must take into account the points of view of the pharmaceutical chemist, public health authorities dealing with diseases, such as cholera, typhoid, malaria, etc., hospitals, private practitioners, and the men carrying out medical and pharmacological research. A drug may have to find a place in the programme of manufacture because it is used in large quantities or it is a vital requirement as a specific for a certain disease. Having prepared a list of drugs and the quantity in each case for a 10 or 15 year plan, the raw materials and intermediates could be calculated, so that the whole scheme may be linked up with that of the dyestuff industry and provision made for the chemicals (*e.g.*, ethyl chlorocarbonate, the alkylamines, cyanacetic acid, etc.) for which the latter industry, as outlined at present, has no need. Only thus could we visualise the establishment of a synthetic drug industry of some magnitude within a reasonable time.

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[1] *Cf.* Morgan and Pratt, *Rise and Development of British Chemical Industry.*

[2] *Cf.* Bruce, *loc. cit.* "In the chemical industry such plants are available in only one or two of the biggest industrial countries in the whole world, and they cannot be improvised to function in an emergency. Some of them take years to build and almost as long a period elapses before their functions are being discharged with high efficiency."

ANTHROPOLOGICAL SURVEY OF THE PEOPLE OF THE UNITED PROVINCES

THE Government of India on the recommendation of the Census Commissioner for India has sanctioned a grant-in-aid for the statistical analysis of the anthropometric data collected by Dr. D. N. Majumdar of the Lucknow University in collaboration with the late census superintendent of the U.P. in respect of the castes and tribes of the United Provinces. In view of the scientific importance of the work the Statistical Laboratory, Calcutta, under the direction of Prof. P. C. Mahalanobis has agreed to share half the cost of this analysis out of its own funds. The total cost is estimated at Rs. 9,000.

Recent statistical analysis of anthropometric data has shown how unsafe it is to build on data collected on small groups of people. The chief errors made with regard to the matter have been in supposing (*a*) that a small sample made up by fewer than 100 individuals is capable of giving an adequate estimate of the form of the distribution in the population sampled, (*b*) that mere inspection of the diagram for a sample is sufficient to reveal the information required. It is necessary to have a sufficiently large number of persons in order to get the proper frequency curve. With this end in view, 20 random samples of important cultural groups of the United Provinces have been measured, each sample consisting of 150 to 200 individuals.

Risley's data constitute at present, the most extensive series of individual measurements relating to Indian castes and tribes available for scientific work. The measurements were taken nearly 50 years ago at a time when the methodology had not been standardised. The statistical treatment was superfluous but far-reaching conclusions have been drawn and have found their way into official documents and popular treatises. The individual measurements collected during the 1931 Census are not available for scientific examination.

Measurements relating to about 4,000 individuals have been collected in accordance with accepted modern technique. The material offers a valuable opportunity for a critical and scientific examination of the very foundations of Indian anthropometry. An appropriate statistical tool is available in the Generalised Distance (D^2-Statistic) the validity of which was fully acknowledged by Prof. R. A. Fisher in his paper on "Statistical Utilisation of Multiple Measurements" (*Annals of Eugenics*, 1938, 8, 376). It has not been possible, however, to use this new tool, so far, for lack of suitable material.

A detailed analysis of the anthropometric material collected now will help us in solving the basic problems of comparative anthropometry. It will show for example, how far the Generalized Distance can be used for an objective classification of castes and tribes or races of human beings. Secondly, it will enable a standard panel or list of measurements being selected for comparative purposes. This will not only simplify and standardise the procedure of field work in anthropology but will enable valid comparisons being made between measurements taken by different observers. Thirdly, it will enable a critical comparison being made between results based on physical and cultural methods of study. Finally the proposed analysis will supply a scientific basis for the comparative anthropology of the United Provinces and North India generally.

A joint report by Prof. P. C. Mahalanobis and Dr. D. N. Majumdar will be submitted to the Government of India. Besides this survey, a monograph on some of the important tribes and castes of the U.P. will also be published for which the Provincial Census authorities have already sanctioned Rs. 1,500.

LETTERS TO THE EDITOR

IMPROVED FORMULÆ FOR THE COEFFICIENT OF CONTINGENCY

IN Statistics, the number which summarises the mutual dependence of two attributes, say, A, B, of the elements of a universe is called a coefficient of contingency. If the classification of the A's is s-fold and that of the B's t-fold, there will be st classes of the type $A_m\, B_n$, $m \leqslant s$, $n \leqslant t$, whose frequencies a_{mn} may be set out in the form of a contingency table of s rows and t columns. If we write $\sum_{n=1}^{t} a_{mn} = x_m \neq 0$, $\sum_{m=1}^{s} a_{mn} = y_n \neq 0$, $S = \sum_{m=1}^{s} \sum_{n=1}^{t} a_{mn}^2 / x_m y_n$, the coefficient of mean square contingency, C, proposed by Karl Pearson is, in effect, equivalent to $\sqrt{1 - \frac{1}{S}}$. It is known that the coefficients calculated from the formula by varying s and t are not strictly comparable, as they are related to varying maxima. Tschuprow's modification

$$T = C/(1 - C^2)^{\frac{1}{2}}\ (s-1)^{\frac{1}{4}}\ (t-1)^{\frac{1}{4}}$$

remedies the defect only when $s = t$.

It is not perhaps generally known that the maximum value of S can never exceed the lesser of the two numbers s and t. Since $a_{mn}/x_m \leqslant 1$, S does not exceed $\sum_{m=1}^{s} \sum_{n=1}^{t} a_{mn}/y_n = t$; and $S = t$ only when $a_{mn} = x_m$, *i.e.*, in each row, all the frequencies vanish except one. Similarly $S \leqslant s$. It will now be clear that the maximum values of C and T are $\sqrt{(s-1)/s}$, and $\sqrt[4]{(s-1)/(t-1)}$ respectively, when $s < t$. To illustrate the point numerically, let $s = 7$, $t = 20$; then C will be less than $\sqrt{6/7} < \cdot 93$, while T is less than $\sqrt[4]{6/19} < \cdot 75$; Tschuprow's coefficient fares worse than Pearson's and underestimates the association.

It is therefore desirable that C and T should be replaced by a coefficient whose maximum is exactly unity. We suggest two formulæ, one based on C and the other on T:

1. $K_1 = \sqrt{\dfrac{(S-1)s}{S(s-1)}} = C \Big/ \sqrt{\left(1 - \dfrac{1}{s}\right)}$;

2. $K_2 = \sqrt{\dfrac{S-1}{s-1}} = T / \sqrt[4]{(s-1)/(t-1)}$;

where s is the number of cells in the shorter array of the contingency-table.

A. A. KRISHNASWAMI AYYANGAR.

Maharaja's College,
Mysore,
November 30, 1941.

ABSORPTION SPECTRA OF POTASSIUM PERMANGANATE IN DIFFERENT MEDIA

THE characteristic intense colour of potassium permanganate is attributed mainly to absorption by the permanganate ion. No data are, however, available in the literature in regard to the influence of the medium. The present note reports marked changes in the permanganate absorption produced by the addition of an alkali and acid.

TABLE I

Wave-lengths in Å.U. of the Absorption Maxima

Other observers[1] ..	5710, 5473, 5256, 5054, 4870, 4707, 4544, 4395
Authors	5495, 5255, 5060, 4900

Table I shows the results of one typical series of experiments made with a 0·5 cm. column of 0·0026 N $KMnO_4$. An almost pointolite type bulb run at a constant potential was used as a source of continuous radiation. The absorption spectra were photographed with a Hilger's constant deviation glass spectrograph. The agreement between the wave-length positions of the absorption bands as observed by previous workers and our data is quite good. The bands at λλ4707, 4544 and 4395 were not prominent on our plate due to the poor transmission of the glass prism used and of the weak intensity of the source of radiation; for the same reason, the band at λ5710 was very weak on our plate.

It was very interesting to observe this entire group of bands disappear suddenly as the concentration of the added acid (H_2SO_4) and alkali (KOH) is increased beyond 11·2 N. and 1·0 N. respectively. It is considered that 'complexes' are formed between the permanganate ions and the medium beyond the above range of concentration whose absorption spectrum does not lie in the region investigated.

Our best thanks are due to Dr. R. K. Asundi and Dr. S. S. Joshi for valuable assistance.

M. PRABHANJANA MURTHY.
JAGDEO SINGH.

Chemical Laboratories,
Benares Hindu University,
December 12, 1941.

1 *Die Qualitative Spectrallanalyse anorganischer und organischer*, Körper, Berlin, 1905, 132; *cf.* also Karim and Samuel, *Bull. U. P. Academy*, **3**, 163.

A SAMPLE OF SHARK LIVER OIL UNUSUALLY RICH IN VITAMIN A

OVER a hundred samples of fish liver oil, the great majority of which were shark liver oil, have been tested in the Nutrition Research Laboratories within the last 2 years. The results of 51 tests were given in a previous paper by the author.[1] Values obtained by the spectrophotometric and the tintometric methods ranged from 450 to 50,100 international units of vitamin A per gramme, with an average of about 13,600 in the case of shark liver oil. No oil giving a value higher than 50,100 was included in this series.

A sample was recently sent for test by the Director of Industries, Sind. This was examined by both the spectrophotometric and tintometric techniques. By the former method, applied both to the whole oil and the non-saponifiable fraction, the very high value of 190,000 I.U. per gramme (in round figures) was obtained. A medium quartz spectrograph, and a 1 cm. cell were used. The method of saponification was that of Dann and Moore.

Calculations were as follows:—

1. *Whole oil in absolute alcohol.*
   Dilution: 3·774 mg. in 100 ml.
   Density readings recorded: 0·30 to 0·70.
   Extinction co-efficient: 0·45.
   $E^{1\%}_{1\ cm.}$ at 328 mμ = 119
   119 × 1,600 = 190,400 I.U. of vitamin A per gramme.

2. *The non-saponifiable fraction was prepared and diluted in absolute alcohol.*

Dilution: 3·428 mg. in 100 ml.

Density readings recorded: 0·25 to 0·70.

Extinction co-efficient: 0·40.

$E^{1\%}_{1\text{ cm.}}$ at 328 mμ = 117

$117 \times 1{,}600 = 187{,}200$ I.U. of vitamin A per gramme.

The conversion factor of 1,600 is that recommended by the League of Nations.

With the Lovibond Tintometer, a Carr-Price value of 3,735 was obtained on the whole oil. If the factor suggested by the author[1] for the conversion of the Carr-Price value given by the non-saponifiable fraction of shark liver oil into international units (50-55) is applied, the value obtained in terms of international units approximates to that given by the spectrophotometric technique. With oils of very high blue value, the Carr-Price values given by whole oil and the non-saponifiable fraction are usually of the same order. The calculations in the case of the tintometric test were as follows:

Dilution of whole oil in chloroform: 3·32 mg. in 100 ml.

0·2 ml. of this solution and 2 ml. of $SbCl_3$ gave 6·2 blue, 1·5 yellow and 0·6 neutral units on the Lovibond scale.

Carr-Price value = 3,735.

In the series of vitamin A values for fish liver oils given by Fixsen and Roscoe,[2] only two oils are listed giving values higher than the above sample. These were halibut and California mackerel liver oils respectively.

At present little is known about the factors responsible for the very considerable range of variation in the vitamin A content of shark liver oil. If samples like the above can be frequently obtained, they should be of great value as a substitute for proprietary vitamin A concentrates now in the market. The supply of the latter to India is likely to be restricted as a result of the war.

K. Rajagopal.

Nutrition Research Laboratories,
Indian Research Fund Association,
Coonoor,
January 17, 1942.

1 Rajagopal, K., *Ind. Jour. Med. Res.*, 1941, **29**, 575.
2 Fixsen and Rosco, *Nutr. Abstr. and Rev.*, 1939, **9**, 795.

STUDIES IN INSECT NUTRITION—ASSAY OF 'QUALITY' IN CROPS

The present communication relates to a study of the rice moth (*Corcyra cephalonica*, Staint), as the test animal for a determination of the 'quality' in crops.

Two of the cereals, jowar and ragi, both of which constitute the staple food in Mysore and parts of South India, have been investigated. Varieties of the two cereals were obtained from Coimbatore Agricultural College, through the kind courtesy of Rao Bahadur G. N. Rangaswamy Ayyangar, Millet Specialist to the Government of Madras. Diets from these samples were prepared in granulated form and feeding experiments conducted with several batches of insects. A proximate analysis of the samples was also carried out.

A study of the data given below (Table I) will reveal the close relationship which exists between the proximate composition and the nutritive value of the grain as revealed by the growth data. With a given cereal, the total nitrogen and the ether extract are the two components which appear to contribute towards the nutritive value of the grain. The two varieties of jowar, A.S. 29 and A.S. 1093, have the same percentage of total nitrogen, but they differ in their fat content. The higher fat content of A.S. 1093 is reflected in the higher increase of weight attained by the insects. In a similar manner, it will be seen that the two jowar varieties A.S. 29 and T_1 which have the same percentage of ether extract (fat), but

TABLE I

Variety	Duration of crop in days	Nature of Crop	Descriptive	Total N	Ether Ext.	Ash	Wt. of larvæ in mgm after:	
				percentages			12 days	20 days
Jowar Series								
A.S. 29 ..	135	Rain fed	Cream colour	1·93	2·12	2·15	29·2	140·0
A.S. 1093 ..	140	,,	,,	1·92	3·67	1·87	34·0	161·6
A.S. 2095 ..	95	Irrigated	Brownish red	1·75	2·69	1·85	26·4	107·5
A.S. 809 ..	100	,,	Yellowish white	2·06	4·63	1·99	44·6	178·5
T_1 .	135	Rain fed	White	1·60	2·13	1·68	21·2	92·0
Ragi Series								
E.C. 593 ..	120	Incurved	Brown	2·04	1·72	3·13	24·0	103·2
E.C. 3517 ..	110	Fist-like	Brownish red	1·93	0·76	2·70	18·0	89·3
E.C. 1507 ..	105	Incurved	,,	1·86	1·69	3·46	24·4	100·0
E.C. 1540 ..	120	White Grain	White	1·76	1 74	3·81	16·8	94·6

which differ in their content of total nitrogen, behave differently with regard to their nutritive values. T_1 has a lower nitrogen content and this is unmistakably reflected in the growth of the insects.

The same conclusions as above, apply to the ragi series. It will, however, be observed that ragi which is comparatively poor in fat, does not promote the growth of the insect to the same extent as jowar. The results have indicated the possibility of employing this insect for comparative studies of the 'quality' in crops. Feeding experiments with rats have confirmed these results. The merit of the 'insect method' lies in the circumstance that only about 20 grams of the material are required for an experiment. It can therefore be adopted for assaying the 'quality of crops obtained from pot culture experiments.

S. RAMASWAMI.
P. S. SARMA.
M. SREENIVASAYA.

Indian Institute of Science,
Bangalore,
February 16, 1942.

CELESTITE IN CIS-INDUS SALT RANGE

WHILE on an inspection tour of the salt outcrops at Ainwan, I went a little further to see the sulphurous spring near Jaba.

In one of the nullahs in which sulphurous water was flowing, my friend Mr. Mannan picked up a white stone. At first, from its specific gravity, I took it to be barite but later confirmed it to be celestite-strontium sulphate. This was followed up-hill leading to the discovery of a few veins of the mineral.

The area is situated about two miles west of Jaba near the path leading to Khairabad in the Mianwali Tehsil in Survey of India Sheet No. 38 $\frac{P}{9}$.

There are two sulphurous springs at the junction of the Murrees with the limestones and these form the source of water supply of the "Karki Wahni" (bitter stream). On the high projection of the nummulitic limestone hill above these two springs are found the celestite veins. The veins occur about 300 feet from the unconformable junction of Murree

sands and shales with the limestones. Gypsum also is predominant near the junction.

The veins of gypsum are from a few inches to three feet in thickness, spread about in the form of a net. At one place the mineral is widely spread about in the limestone. It also occurs in the form of 'geodes' in the limestone.

The celestite occurs in fairly large quantities and roughly 10,000 tons of it are estimated to be available. The mineral is, in addition, of high purity and one sample, on analysis, yielded 99·98 per cent strontium sulphate.

The only mention of its occurrence in the trans-Indus Salt Range is by Wynne in tertiary red clays near Surdog (Kohat). It is hoped that the discovery in the Cis-Indus Salt Range will be of economic importance to India.

B. S. Lamba.

Salt Mines,
Kalabagh (Punjab),
January 13, 1942.

ROAD TESTS OF AUTOMOBILES WITH PETROL-ALCOHOL MIXTURES

The object of the present study was to investigate the validity of the numerous complaints made by the motor users, at any rate during the introduction of the Power Alcohol Scheme, and also to keep going the transport system of the Mysore Sugar Company, Ltd., Mandya, at a time when the supply of petrol for this industry was very much reduced.

A new Ford V-8 lorry (1940 model) of 30 H.P. was the vehicle used for these tests. This vehicle had a cast-iron cylinder head with a compression pressure of 111 lbs. per sq. inch (gauge pressure). The compression ratio of the engine was 6·11 : 1 and the rear axle ratio 4·86 : 1. This lorry was used for transporting cane. The road had a mecadum surface, and had a gradient of 1 in 22 to 1 in 30. A separate fuel tank was fitted to this lorry with an arrangement to add or take off the fuel. Correct mixtures of petrol and alcohol were made and the quantity of fuel used for each trip was measured. The engine was not run when stationary, and conditions of running were maintained as uniform as practicable under road conditions. An average speed of 10 to 15 miles per hour was maintained. The performance of the engine in each case was noted, and remunerative work is expressed in ton-miles in each case. There was a large variation in the readings obtained as a great deal depended upon the driver which is a personal factor.

A table representing a fair average of the running conditions of the vehicle is given below.

The volumetric efficiency of the fuel increases as the percentage of alcohol is increased in the fuel up to 15 per cent., and from 15 to 30 per cent there is a gradual fall in efficiency so that it attains a value equal to that of petrol. The efficiency goes on falling up to 50 per cent. alcohol and the performance of the engine with regard to acceleration, and absence of "knocking" are practically the same as with pure petrol. In fact the running was much smoother in the case of these mixtures than with pure petrol. As the percentage of alcohol increases to 55 per cent. it was found that the starting of the engine from cold was rather slow. In these cases (*i.e.*, fuel containing 55 to 70 per cent. alcohol) a gradient of 1 in 22 to 1 in 30 had to be negotiated at second gear, whereas in the case of fuel containing less than 55 per cent. the same gradient was negotiated at top gear.

In the case of fuels containing from 80 per cent. alcohol to pure alcohol, the same starting troubles from cold were experienced. The vehicle had to be run with the "choke" fully pulled. The acceleration of the engine was very poor and the same gradient had to be negotiated on the third gear.

Regarding the cost of fuel, it is clearly seen that 50 per cent. alcohol in the fuel can be safely used, provided the Government can release the alcohol at a flat rate of Rs. 1-2-0 a gallon to the consumer, as it is possible for them to do so.

Acknowledgements are due to the General Manager, Mysore Sugar Company, Ltd.,

Road Test with Petrol-Alcohol Mixtures on the New Ford V-8 Lorry No. A-2355

Percentage of Alcohol in mixture	Remunerative work done in Ton-miles per gallon	Cost of Fuel per gallon Rs.	A.	P.	Cost of fuel per Ton-mile in Pies	Remarks
0 Pure Petrol	51·1	1	12	6	6·69	Easy starting; Hill negotiated with top-gear. Acceleration good.
5	52·7	1	11	11·7	6·37	
10	54·6	1	11	5·4	6·03	
15	57·1	1	10	11·1	5·66	
20	53·8	1	10	4·8	5·89	
25	53·1	1	9	10·5	5·85	
30	51·5	1	9	4·2	5·91	
35	48·2	1	8	9·9	6·18	
40	47·2	1	8	3·6	6·18	
45	46·8	1	7	9·3	6·10	
50	46·0	1	7	3·0	6·06	
55	36·1	1	6	8·7	7·55	Starting slow; Hill negotiated with second gear. Acceleration poor.
60	34·7	1	6	2·4	7·68	
70	31·7	1	5	1·8	8·00	
80	25·5	1	4	1·2	9·46	Starting slow; Vehicle run with choke fully pulled. Acceleration poor. Hill negotiated with 3rd gear only.
100 Pure Alcohol	21·7	1	2	0	9·95	

Average Speed.—10–15 miles per hour.

Petrol used.—Commercial B. O. C. petrol.

Alcohol used.—Absolute Alcchol of strength 99·7% by volume denatured with 2% denaturing grade methanol.

Mandya, for the facilities and guidance given for the carrying out of these tests and to the Transportation Superintendent, Mysore Sugar Company, Ltd., and his assistants for their co-operation.

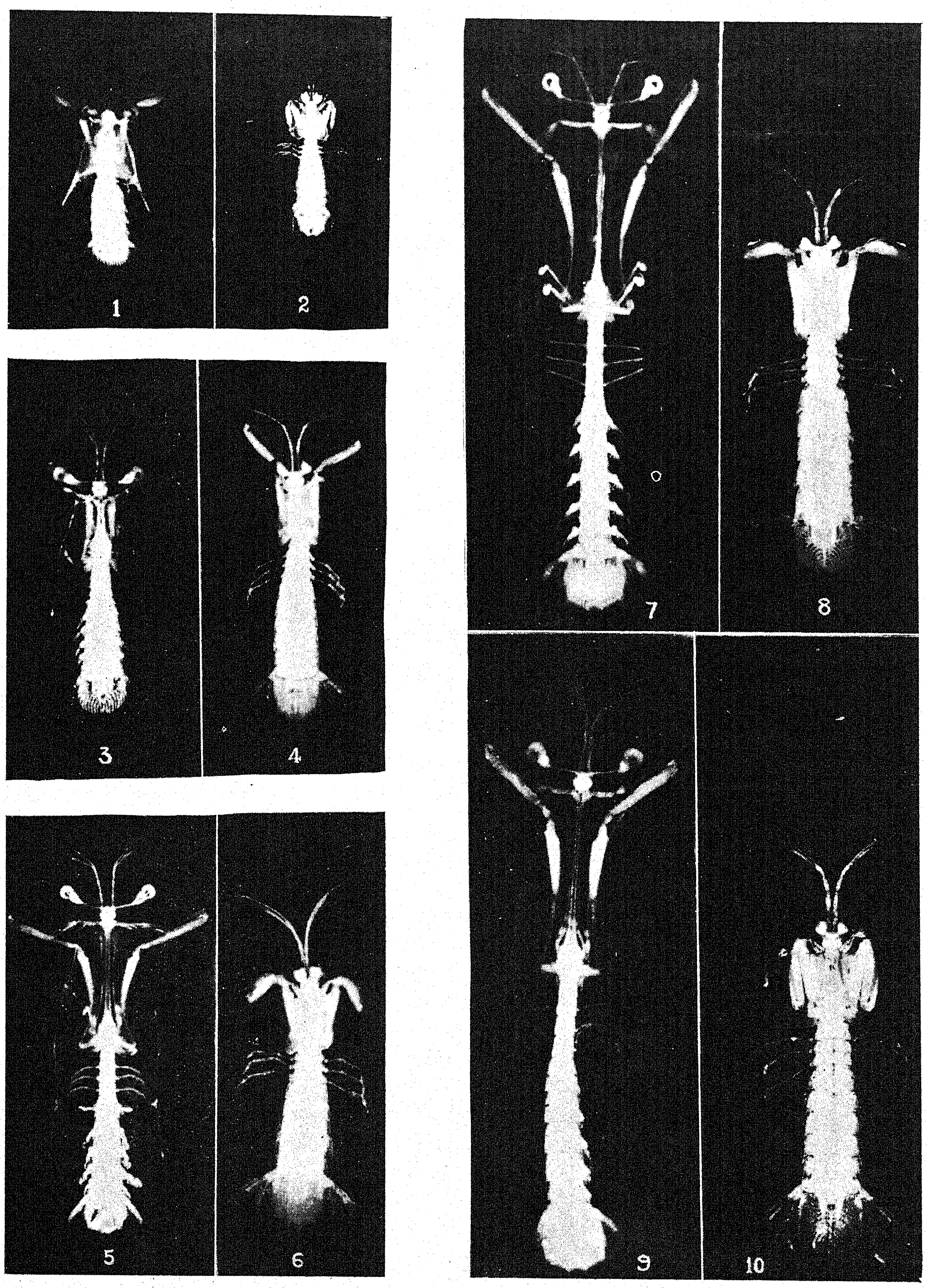
G. Narasimha Iyengar.

Distillery,
Mysore Sugar Company, Ltd.,
Mandya,
February 4, 1942.

ON SOME *SQUILLA* LARVÆ FROM THE MADRAS PLANKTON

The larval stages of Stomatopods have been studied by various authors like Muller (1862, 1863), Claus (1871), Faxon (1882), Brooks (1886, 1893), Bigelow (1894), Hansen (1895, 1926), Jurich (1904), Giesbrecht (1910), Komai (1929) and others. The usual practice has been to collect the various stages from the plankton, arrange them according to their size and state of development and correlate them to the adults, more or less on circumstantial evidence such as the comparative abundance or otherwise of the species occurring in the locality. Since the advanced larvæ of the various species of the genus differ from each other only in minor details there is a great possibility of mixing up the larvæ of allied species in this method of identification. The only sure method, therefore, seems to be to observe, wherever possible, what each particular type of larva metamorphoses into.

Squilla microphthalma, S. raphidea, S. nepa, S. holoschista and *S. wood-masoni* are some of the common species of *Squilla* that occur on the Madras Coast. Plankton collections contain various stages of the larvæ of all these species in fair numbers. With a view to determine the identity of the species to which they belong, larvæ which appeared to be in the final stage of pelagic life were picked out from the plankton, carefully sorted and placed in separate jars of clean sea-water. Most of them were found to have undergone metamorphosis overnight into young squillæ. In the newly metamorphosed forms the specific characters were so clear that



Magnification about $2\frac{1}{3}$ times in each case.

Photographs 1, 3, 5, 7 & 9. Final pelagic larval stage of *Squilla microphthalma*, *S. raphidea*, *S. nepa*, *S. holoschista* and *S. wood-masoni*. Photographs 2, 4, 6, 8 & 10. Same, in each case, 12 hours after metamorphosis.

their identification was a comparatively easy matter though as a precaution they were kept for a few days longer in the Laboratory aquarium tanks and the identification verified. In this manner the identity of the final stages of the larvæ of all the above-mentioned species has been determined. The photographs given show the final pelagic stage of the larva and the corresponding young *Squilla* into which it metamorphosed in each case. Fuller details in regard to the larval stages of the species of *Squilla* of the Madras Coast will be given in a separate paper.

K. H. ALIKUNHI.
R. GOPALA AIYAR.

University Zoological Research
Laboratory, Madras,
February 11, 1942.

Bigelow, R. P., *Proc. U. S. Nat. Mus.*, 1894, **17**.
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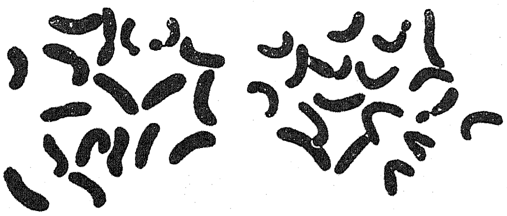
—, *Ibid.*, 1863, **29**.

CHROMOSOME NUMBER IN *CARICA*

THE genus *Carica* consists of nearly 50 species (*vide* Index Kewensis) all of which are indigenous to Tropical America and are described as diœcious except *C. papaya*, in which different sex types have been noted. In connection with an investigation into the cytology of the different sex types of *C. papaya** it was felt that an examination of the chromosomes of the strictly diœcious species of *Carica* would be helpful. Requests for seeds of different species of *Carica* were sent to various institutes and Agricultural stations in America, but due to the present difficulties of communication we received only seeds of two species, namely, *C. pubescens* Lenne and Koch and *C. posopora* L. Of these the latter did not germinate, while plants of the former are being grown for further study.

Examination of the root tips of *C. pubescens* revealed 18 chromosomes at metaphase (Fig. 1). In Fig. 2 a metaphase plate from root tip of *C. papaya* is given for comparison. The same chromosome number has been reported in all the other investigated species of *Carica*; *C. candamarcensis* Hook. fil., *C. cauliflora* Jacq., *C. chrysopetala* Heilborn., *C. Peltata* Hook and Arn., *C. pentagona* Heilborn., and *C. quercifolia* Benth. and Hook. (Storey, 1941).[1] Storey has stated that though no critical comparative study of the chromosomes have been made, these species exhibit chromosomes more or less similar in size and morphology suggesting a close relationship among them.



1 2

Somatic metaphase from *C. pubescens*. × 3,000
Somatic metaphase from *C. papaya*. × 3,000

In *C. pubescens* we note that the chromosomes are slightly larger than those of *C. papaya*, though the number is the same and position of attachment constriction is median or submedian in all the chromosomes of both species. No distinctly heteromorphic pair of chromosomes could be noted in this diœcious species also.

We are indebted to His Majesty's Consul-General at Havana, Cuba, for the seeds of the two species of *Carica*.

L. S. S. KUMAR.
A. ABRAHAM.

College of Agriculture,
Poona,
December 22, 1941.

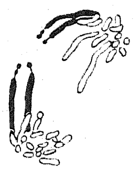
* Scheme of research on the " Cytology of Papaya " financed by the I. C. A. R.

[1] Storey, W. B., 1941: *Hawaii Ag. Expt. Station Bull.*, No. 87, pp. 6–7.

A PROBABLE CASE OF TRANSLOCATION DURING MITOSIS INVOLVING THE SATELLITE THREAD

IN the course of an examination of the somatic chromosomes of *Muscari plumosum* I found a chromosome in anaphase bearing three satellites (Fig. 1). *Muscari plumosum* ($2n = 18$) has one pair of satellited chromosomes of which one has tandem satellites (Fig. 2).

1

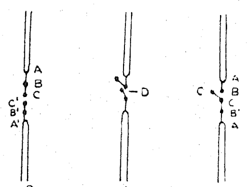


2

FIG. 1. Root smear of *Muscari plumosum* stained with decolourised basic fuchsin (× 1,800); the chromosomes with tandem satellites in the separating groups are marked L and L′.

FIG. 2. Somatic anaphase in *M. plumosum*, showing the sat. Chromosomes (× 1,350).

The presence of three satellites may be explained by assuming a translocation involving the two chromosomes with tandem satellites in the separating groups. It is well known that during anaphase the separating chromosomes are subject to a great deal of disturbance due to the stretching of the spindle.[1] It is possible that while separating, the sat. end of the lower chromosome has been pushed against its opposite number in the upper group so as to bring "C′" in contact with the sat. thread near "B". When once there is an



3 4 5

FIGS. 3–5. Diagrams illustrating the translocation.

overlap, a break and reunion would follow as a result of the stress of anaphasic separation. The lower chromosome would then have three satellites due to the transfer of the terminal segment B–C of the upper chromosome on to "C′".

Simple translocation involving the sat. chromosomes has been reported by the author[2] in a species of Calceoloria, but this involved break and reunion at two loci, *i.e.*, one near the satellite and the other on the body of chromosome, resulting in one long chromosome with a tandem satellite and a short one without any. Such translocations are known to have occurred naturally in a number of cases, the first one reported being that in non-irradiated Drosophila (Bridges[3]).

K. V. SRINATH.

Department of Botany,
Intermediate College,
Bangalore,
September 25, 1941.

1 Belar, K., *Arch. f. Entwin.*, 1929*a*, **118**, 359.

2 Srinath, K. V., *Zeit. f. Abst. Vererbgsl.*, 1939, B **77**, H.I., 104.

3 Bridges, C. B., *Genetics*, 1917, **2**, 445; *Anat. Rec.*, 1923, **15**, 357.

TWO NEW SPECIES OF *ASPIROMITUS* St. FROM BOR-GHAT (LONAVALA & KHANDALA)

BY a strange coincidence the *Genus aspiromitus* St. from Bor-Ghat (Lonavala and Khandala) happens to be worked upon at two places at the same time. Mahabale[1] has described a new form from Khandala and makes it a new species. In the Botanical Laboratory of the Fergusson College, Poona, work has been in progress on *Riccia, Anthoceros, Notothylas* and *Aspiromitus* from Bor-Ghat and places near Poona, for the last few years. In November 1940, specimens of *Anthoceros* and *Aspiromitus* were sent, along with observations made on them, to Dr. S. K. Pande of Lucknow. A paper giving a detailed description of the different forms of *Anthoceros* Linn. and *Aspiromitus* St. collected so far from the localities mentioned above, has been sent to the Editor, *Bombay University Journal*, for publication and is expected to appear in the next issue of that periodical. It is thought necessary, in view of Mahabale's note, to report in *Current Science* the distinctive features of the two species of

Aspiromitus St. investigated at the Fergusson College, Poona. These species are quite new to science and are very common at Bor-Ghat (Lonavala and Khandala).

I. *Aspiromitus khandalensis, Apte and Sane, sp. nov.*—Dioecious. Thallus circular, dark green in colour, up to 40 mm. in diameter, deeply lobed, cavernous, firmly attached to the substratum by the ventral surface except at the margins. Segments oblong or wedge shaped, overlapping along the lateral margins and slightly ascending towards the apices. Surface cells about 28μ, as long as broad, polygonal or rectangular. The single female thallus bears a large number of capsules up to 75. Involucre 4–5 mm. long. Capsules stomatiferous and up to 40 mm. long. Stoma $56\mu \times 35\mu$. Spores up to 60μ in diameter, dark black, with blunt spines. Pseudo-elaters many celled, short, bent and sometimes branched. Male plants small, with many antheridial chambers on the dorsal side; each chamber contains more than 30 antheridia; the antheridium measures $175\mu \times 91\mu$.

II. *Aspiromitus Fergussoni, Apte and Sane, sp. nov.*—Dioecious. Thallus a rosette, 40–45 mm. in diameter, light green in colour, with four or five, rarely more, deep, slightly overlapping lobes. Lobes truncate in form, prostrate or sub-erect and 15–20 mm. long. Surface cells $35–42\mu \times 49–63\mu$, rectangular or polygonal. Capsules 20–40 on a single plant, stomatiferous, about 40 mm. rarely 50 mm. long. Stoma $63\mu \times 42\mu$. Involucre cylindrical, up to 7 mm. long, solitary or fused in twos or threes. Spores $36–40\mu$ in diameter, dark black in colour with spiny surface. Elaters multicellular, straight, extremely elongated with or without branches. Male plants small, upper portions of the lobes studded with conspicuous yellow antheridial chambers. Each chamber contains numerous antheridia, generally 40 but more than 100 have also been noted. The antheridial body is large and measures $160\mu \times 100\mu$.

It will be seen that the spore and elater characters of *A. Dixitianus*, Mahabale, agree with those of *A. Fergussoni*, but the latter differs greatly from the former in (*i*) the form and size of the thallus, (*ii*) the lengths of the capsule and the involucre, and (*iii*) the number and size of antheridia. Perhaps Mahabale's description of these characters in *A. Dixitianus* may possibly agree with that of the juvenile condition of *A. Fergussoni* and a suspicion arises that Mahabale might have based his new species on the study of only young stages of *A. Fergussoni*. This point will have to be settled in the future work on these forms.

V. V. Apte.
P. V. Sane.

Department of Biology,
Fergusson College,
Poona 4,
January 16, 1942.

1 Mahabale, T. S., *Curr. Sci.*, 1941, **10**, 530.

SOME OBSERVATIONS ON AN "IMPROVED METHOD FOR THE DETERMINATION OF PROTHROMBIN TIME"

The "improved method"[1] introduced two ideas, though in practice the change is only in one step. The first idea is, that instead of adding thromboplastin to the oxalated plasma, incubating the mixture and then adding the calcium chloride, it is as reasonable to bring together calcium and thromboplastin and add this mixture (calcium and thromboplastin simultaneously) to the oxalated plasma in one step. We may add that this procedure has already been recommended or adopted by Napier and Das Gupta.[2] But we would submit that this is not entirely in accordance with the principle of Quick's test. The second idea is to reduce the dilution of prothrombin in the plasma with the hope of shortening the prothrombin time. "Both these problems were solved by adding directly to the plasma 0·2 c.c. of 1 in 20,000 venom solution in 0·025 calcium chloride." The total volume of the reaction mixture was thus reduced to 0·4 c.c. instead of 0·6 c.c. when thromboplastin and calcium solution were separately prepared as in Fullerton's work.[3] This modification, the authors point out,

resulted in an increase in the concentration of the prothrombin in the reaction mixture by about 33 per cent. Fullerton obtained a prothrombin time of 18 to 25 sec.; while the prothrombin time with the "improved method" was 8 seconds.

After reading the above communication on "the improved method", we first carried out a series of estimations of prothrombin time introducing similar variations in Quick's method, *i.e.*, using thromboplastin from rabbit's brain. In one series, we first estimated the prothrombin time of plasma according to the usual technique of Quick[4] (adding thromboplastin to the oxalated plasma, incubating the mixture and then adding calcium chloride). Immediately after, we estimated the prothrombin time of the same specimens, making a simultaneous addition of thromboplastin and calcium to oxalated plasma. The prothrombin time was not shortened by the alteration in the procedure. In a second series, after estimating the prothrombin time of plasma according to the orthodox Quick's method, we adopted the procedure recommended by the Calcutta workers, namely, adding directly to plasma a solution of thromboplastin in 0·025 M. calcium chloride. Even after this procedure, which reduced the total volume of the reaction mixture from 0·3 c.c. to 0·2 c.c. the prothrombin time was not reduced. The results were somewhat inconstant but in no case did we obtain any marked reduction, on account of the increased concentration of prothrombin.

Finally, we made a third series of observations closely following the procedure adopted by Calcutta workers. We used Boot's 'Rus Ven' in a dilution of 1 in 20,000. To our great surprise, we did not find any marked reduction as indicated by the results of Calcutta workers. Details and results are omitted for want of space. It has been pointed out to us that the sample of venom we used was not very potent having been kept in Vizag for some months under varying conditions of temperature. We admit the possibility of reduced potency in the sample we employed. It is possible that they used fresh and more potent venom. The question then arises whether one can expect the same degree of reduction in prothrombin time with different venoms used, according to the improved technique.

The necessity to shorten the prothrombin time is not obvious. Some workers[5] have found that the time interval according to Quick's method (12–25 seconds) was too short and likely to give rise to errors and inaccuracies in observation and suggested a modification, *viz.*, using Heparin as anticoagulant to prolong the time-interval. According to Calcutta workers it is an advantage to have a shorter test time. While the majority of workers who have used Quick's test admit the inconvenience of preparing fresh thromboplastin for every batch of tests, none complained of any technical difficulty in accurately observing the end point, which Illingworth[6] particularly mentions as exact.

It was determined by simply noting when the mixture coagulated and not by noting the "formation of the fibrin web in the opaque solution". It was Fullerton who took this latter criterion as the end point.

D. V. S. Reddy.
C. Venkataramiah.

Department of Physiology,
Andhra Medical College,
Vizagapatam,
November 8, 1941.

1 Iyengar, N. K., Sehra, K. B. and Mukerji, B., *Curr. Sci.*, 1941, **10**, 326.
2 Napier, L. E., and Das Gupta, *Ind. Med. Gaz.*, 1941, **76**, 229.
3 Fullerton, H. W., *Lancet*, 1940, **2**, 195.
4 Quick, A. J., and Leu, M., *J. Biol. Chem.*, 1937, **119**, 81; *J. A. M. A.*, 1938, **110**, 1658; *Am. J. of Med. Sci.*, 1940, **199**, 1.
5 Dam, H., and Glavind, J., *J. A. M. A.*, 1940, **115**, 149.
6 Illingworth, C. F. W., *Lancet*, 1939, **1**, 1031.

There seems to be a certain amount of confusion of ideas with regard to the correct interpretation of the results communicated in

our note in *Current Science*.[1] The author of this letter would have found all the answers to the points raised by him in the full paper which has been accepted for publication in the *Indian Journal of Medical Research*, 1942.

(1) Regarding the 'priority' question, the idea of combining thromboplastin and calcium in the same solution was evolved in the Biochemical Standardisation Laboratory and actually solutions were supplied to Dr. Das Gupta to enable him to carry out routine prothrombin determinations on a large scale. Our idea was to collect sufficient data before actually claiming the advantages of our method over other methods already in existence. In the paper by Napier and Das Gupta referred to by the author, the name of one of us (N. K. I.) actually occurs (*I.M.G.*, Vol. 76, p. 232).

(2) Regarding the question of 'speeding-up' of the reaction, the author seems to have the impression that the "prothrombin time" is reduced from 18 secs. to 8 secs. By employing Fullerton's technique and using a solution of Russell viper venom available in this Laboratory (and not 'Rus-Ven' of 'Boots' or 'Stypven' of B.W. & Co.), the prothrombin time has been found to be 11–14 seconds. Using the same venom solution and combining it with calcium the 'prothrombin-time' was found to be 8–10 secs. The reaction time is therefore speeded up only to this extent, and not from 18 secs. to 8 secs. as probably inferred by the author. In the complete paper submitted for publication, comparative figures of prothrombin-time of normal human plasma, as determined by the two methods (Fullerton's and ours) are given.

(3) Regarding the end-point determination, Fullerton suggested that 'first appearance of the fibrin web' was a good criterion. Employing this criterion, it was found that the results were more reproducible. There is a certain amount of lag between the *first appearance of fibrin web* and the final *setting* of the clot. It is advisable to watch for the first appearance of the process of clotting when it is possible to do so, as in this particular solution. Rabbit's brain extract, as originally used by Quick, would be so opaque as not to permit the observation of this rather fine criterion. This is probably the reason why Quick has not mentioned this as the criterion.

The author has not stated the *positive side* of his investigation, *i.e.*, the actual 'prothrombin time' obtained by using our technique. It would have been easier for us to estimate the divergence of results if this information was supplied. We shall be glad to send the venom used by us for any further work that the author wishes to do to settle these points.

B. MUKERJI.

December 15, 1941.

[1] *Curr. Sci.*, 1941, **10**, 326.

RAINFALL FREQUENCY AT PATIALA

BY

L. D. MAHAJAN

(Mahendra College, Patiala)

SOME years ago, Mr. L. J. Sedgwick,[1] I.C.S., of Bombay, studied "the frequency of rainfall at five stations in the south of the Bombay Presidency" and deduced certain results regarding the variations of rainfall in those regions. In the present note, the frequencies of rainfall at Patiala which lies in the south of the Punjab have been studied in a similar manner.

The frequencies have been broken up into a number of classes and each class covers a range of 0·20 inches. The classes are arranged in groups, each having five classes and covering a range of 1·00 inch. For detailed and more accurate study, the rainfall from 0·01 to 1·00 inch (group 1) has also been divided into ten equal sub-classes, each covering a range of 0·10 inch (Table I).

The rainy days having rain less than 0·01

[1] L. J. Sedgwick, *Memoirs of the India Meteorological Dept., Poona*, **23**, Part 8.

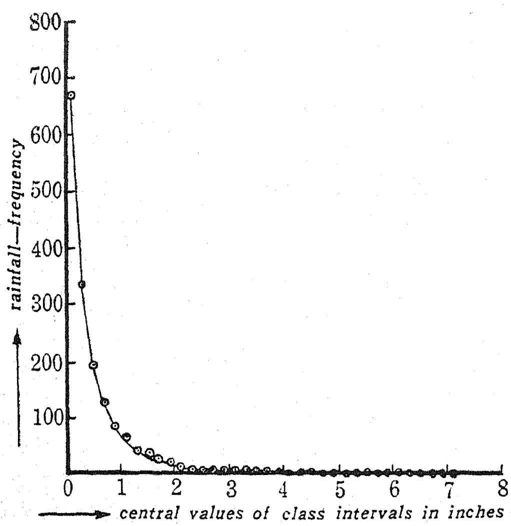
TABLE I

Table of Rainfall Frequencies, Patiala (South Punjab)

No.	Class	1901-10	1911-20	1921-30	1931-40	Totals 1901-40	Group totals	Rainfall due to each class in inches
1	0·01—0·10 0·11—0·20	121 77 } 198	58 89 } 147	103 87 } 190	52 78 } 130	334 331 } 665	} 1415	66·5
2	0·21—0·30 0·31—0·40	45 36 } 81	51 37 } 88	54 42 } 96	43 30 } 73	193 145 } 338		101·4
3	0·41—0·50 0·51—0·60	28 23 } 51	27 23 } 50	35 16 } 51	29 16 } 45	119 78 } 197		98·5
4	0·61—0·70 0·71—0·80	20 14 } 34	17 12 } 29	15 14 } 29	21 17 } 38	73 57 } 130		91·0
5	0·81—0·90 0·91—1·00	14 11 } 25	9 13 } 22	10 14 } 24	11 3 } 14	44 41 } 85		76·2
6	1·01—1·20	21	15	15	16	67		73·7
7	1·21—1·40	10	14	5	15	44		57·2
8	1·41—1·60	9	10	13	8	40	202	60·0
9	1·61—1·80	11	7	3	8	29		49·3
10	1·81—2·00	3	8	5	6	22		41·8
11	2·01—2·20	11	2	0	2	15		31·5
12	2·21—2·40	1	4	2	2	9		20·7
13	2·41—2·60	3	1	4	4	12	53	30·0
14	2·61—2·80	1	3	3	3	10		27·0
15	2·81—3·00	2	1	2	2	7		20·3
16	3·01—3·20	2	1	3	1	7		21·7
17	3·21—3·40	1	5	1	2	9		29·7
18	3·41—3·60	0	2	2	2	6	27	21·0
19	3·61—3·80	1	1	1	0	3		11·1
20	3·81—4·00	1	0	0	1	2		7·8
21	4·01—4·20	0	0	0	0	0		0·0
22	4·21—4·40	0	0	1	1	2		8·6
23	4·41—4·60	0	0	0	0	0	5	0·0
24	4·61—4·80	0	1	0	1	2		9·4
25	4·81—5·00	1	0	0	0	1		4·9
26	5·01—5·20	0	0	0	0	0		0·0
27	5·21—5·40	1	0	0	1	2		10·6
28	5·41—5·60	0	0	0	0	0	5	0·0
29	5·61—5·80	0	1	0	0	1		5·7
30	5·81—6·00	0	1	0	1	2		11·8
31	6·01—6·21	0	0	0	0	0		0·0
32	6·21—6·40	0	1	0	0	1		6·3
33	6·41—6·60	1	0	0	0	1	2	6·5
34	6·61—6·80	0	0	0	0	0		0·0
35	6·81—7·00	0	0	0	0	0		0·0
36	Above 7·00	0	0	0	0	0	0	0·0
	Totals	469	414	450	376	1709	1709	1000·5
	Mean Annual Rainfall ..	26·60	26·69	22·89	24·98	25·29	Average heaviness	0·58

inch are counted as rainless days in the table. The data which are used in the table have been collected from various sources. They extend from 1901 to 1940. The frequencies are given for each ten years period as well as for the whole period. The last two rows give the totals of frequencies and the mean annual rainfall for each decade.

A curve has been drawn (Fig. 1) representing the relation between frequencies (totals of frequencies for the whole period) and the central values of the class intervals. It is almost L-shaped, *i.e.*, the frequencies fall very



rapidly with the increase of rainfall amount, but for high classes they become almost constant and are very very low. This curve agrees with those of Mr. Blanford obtained for a few stations and used in his book on "Climates and Weather of India", and also with those obtained by Mr. L. J. Sedgwick for a few stations in the south of the Bombay Presidency and used in his paper on "the rainfall frequencies at five stations in the south of the Bombay Presidency".

The comparison of frequencies given in Table I clearly indicates that the light showers of the middle value 0·10 inch and range 0·01 to 0·20 inch (class 1) are more common than the showers of higher middle values (higher classes), and the comparison of frequencies of the sub-classes in group I shows that the showers of the first two lowest ranges 0·01 to 0·10 inch and 0·11 to 0·20 inch have very high and almost equal frequencies. The table also indicates that the frequency decreases with the rise of class very rapidly.

The last column in the table gives the approximate total rainfall yielded by each class during the whole period of forty years. It shows that the greatest amount of rainfall is contributed by falls of about 0·30 inch middle value and next to it (nearly the same) by falls of about 0·50 inch middle value. The average heaviness of the rainfall, *i.e.*, the average rainfall for each rainy day is 0·58 inch. Thus the greatest quantity of rain is yielded by falls not differing much from those of average heaviness which confirms Blanford's statement.

The other point of interest is a marked diminution in the number of falls of the lowest value class in the second and the fourth decades which is indicated by the values given in class 1. The value is the lowest in the last decade which shows a possible decline in the frequency of the lowest class. But such change is not visible in the higher classes.

Moreover, it also shows that on the whole the frequency of rainfall is decreasing with time which is indicated by the totals of frequencies for each decade. The comparison of frequencies and the mean annual rainfall for each decade indicates that the latter does not merely depend upon the former. There had been never any rainfall of value higher than 6·60 inches during the last forty years.

Besides, the examination of annual rainfall[2] of the last forty years indicates that on the whole the annual rainfall is decreasing irregularly with the years.

The author is indebted to His Highness' Government, Patiala, for providing facilities to carry out the above work in the Research Laboratory of Mahendra College, Patiala.

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[2] A separate paper is being published on this subject by the author.

REVIEWS

Chemical Species (*La Notion D'Espece En Chimie*). By Jean Timmermans. Translated by Ralph E. Oesper. (Macmillan, London), 1941. viii + 177. Price 18*sh.*

We owe to Lavoisier, among so many other things, a correct exposition of the meaning of the word 'element'. The famous controversy between Berthollet and Proust was responsible for bringing out clearly the difference between definite compounds and mixtures. Since then our ideas about chemical species have become clearer as a result of progress in chemical theory on the one hand and the accumulation of exact experimental data on the other. But, confusion in distinguishing between different types of homogeneous substances—leaving aside the question of isotopes in elements—has not been rare. In fact, as late as 1908, Le Chatelier found it necessary to say "The inorganic chemists (less favoured than their organic brethren) have too often allowed themselves to be seduced into artificially augmenting the number of real compounds."

Preparation of pure materials, determination of the purity of substances, identification of the homogeneous nature of different kinds of matter by physical and chemical criteria is supposed to be and should be an essential part in the training of a chemist. Le Chatelier's accusation, however, would never have been made if such training had been uniformly imparted in all chemical research centres to investigators at some stage of their chemical education. The need for a thorough training in the foundations of chemical science is as great to-day as ever before and should an outline of a sound scheme for such education be needed, one has only to secure a copy of Prof. Timmermans 'Chemical Species' translated from the French original into English by Prof. R. E. Oesper. The book under notice deals, in an admirable manner, with the different aspects of the points mentioned above. Information of great value is included in the 26 chapters of this small volume of 177 pages. Special mention may be made of two very brief but very important chapters, one on critical appraisal and choice of published data, and the other on scientific and technical applications of pure materials.

La Notion D'Espece En Chimie was first published in 1928. But, as the translator remarks "probably through lack of proper advertising this valuable little book became known to too few chemists and has never been accorded the attention it merits". Prof. Ralph Oesper has rendered a great service to the scientific reading public by translating a specially revised manuscript from which 'both the novice and the seasoned veteran' have much to learn.

A. N. K.

The Applications of Chemical Engineering. Edited by Harry McCormack. (Chapman & Hall, Ltd., London), 1940. Pp. x + 431. Price 21*sh.* net.

This book is the outcome of the recognition of a long-felt need for a practical laboratory handbook on the subject of Chemical Engineering. It is a co-operative effort of the editor and a group of co-authors who are all in the profession of teaching Chemical Engineering in different American institutions. These authors have collected and co-ordinated all the available material on the practical applications of chemical engineering and then have selected only what they deemed suitable for this publication, avoiding unnecessary and unsatisfactory matter.

This book is well printed and well got up. It describes seventy-five experiments covering the important subjects of temperature measurement, flow of fluids and heat, and the unit processes of evaporation, distillation, drying, humidification, gas absorption, classification of solids, and size reduction. We find that the number of these experiments apportioned to the various subjects does not conform strictly to the relative importance of these subjects but this cannot be considered as a drawback because a comprehensive set of experiments is not necessary for an average course of practical training. In the opinion of the editor, one-third of these experiments is sufficient and the teacher may select the most suitable ones for the purpose and the available equipment.

The absence of chapters on industrial crystallisation and conveyance of solids is a little disappointing. The scope of this

treatise will considerably increase by an inclusion of these important subjects.

The scheme underlying the chapters, each of which deals fully with a subject, is quite comprehensive. Each subject is introduced with a description of the underlying general principles in sufficient detail. Then the experiments are described with a statement of the object, details of the necessary equipment and the practical procedure. The preliminary and detailed reports with the forms of recording data and calculations are given. What is perhaps a very helpful feature is that each experiment is concluded with 'sample data' and 'calculations'. There are graphs illustrating general principles and practical results, diagrams and pictorial representation of laboratory equipment and complete bibliography on each subject.

The authors should be thanked for this valuable contribution to the teaching of practical chemical engineering. Those who are keen on equipping their laboratory and drawing up a scheme of experiments in this branch of engineering will do well to consult this work freely. Even the practising chemical engineer finds this a very helpful book when he is called upon to make tests on his large-scale units. In short, this book admirably fulfils one of the wants hitherto felt by the teacher, the student and even the practising chemical engineer.

G. G. RAO.

Text-Book of Physical Chemistry. By Samuel Glasstone. (Macmillan & Co., Ltd., London), 1940. Pp. xiii + 1,289. Price 42*sh.*

It is welcome to have under review this lucid and comprehensive presentation of Physical Chemistry by an experienced author whose other well-known books are "popular" with students, both undergraduate and post-graduate. The avowed object of the book is to "take the student with a very elementary knowledge of Physical Chemistry, such as might be gained in a normal course on general chemistry and lead him by easy stages and with the simplest mathematical methods to such an understanding of the subject as will permit him to appreciate the more advanced treatises and recent Journal literature". Judged as a whole and overlooking a few minor blemishes the author has been eminently successful in achieving this object. By judicious use of small types for difficult matter and suitable appendices to each chapter, the subject-matter has been made clear, interesting and up to date. It is difficult to single out any chapter or chapters for particular mention but the order of presentation starting with the atomic structure, and the modern theories of valency and leading on through radioactivity, thermodynamics, states of matter, etc., progressively covers the entire field of Physical Chemistry in a precise and thoroughly modern manner.

The get-up of the book and the typography are excellent, and there is no doubt that this book will have a wide appeal both to the teachers and to the taught.

An Introduction to Chemistry. *Part I. Inorganic Chemistry.* By A. C. Cavell. (Macmillan & Co., London), 1940. Pp. 512 + xiii. Price 6*sh.*

The aim of the book is to provide a complete course in elementary, theoretical and practical chemistry. The historical notes at the end of each chapter form a new and welcome departure and would no doubt stimulate the interest of the young student in the development of the subject. Emphasis has rightly been placed on the electrochemical series as the basis for the study of metals in an elementary course. A large number of numerical problems are included to familiarise the student with theoretical principles. The collection of well-selected questions at the end of each chapter renders the book very useful as a text-book. Full practical details are included for a large number of experiments.

A few blemishes have to be pointed out. The quantities of chemicals the student is asked to employ in some experiments seem to be excessive (*cf.* pp. 20 and 21). On p. 31, the definition of solubility is incorrect as no mention of saturated solution is made therein. Structural formulae are of value in an elementary course and could usefully have been considered in dealing with the three phosphoric acids. The reversible nature of the effect of heat on calcium carbonate (p. 405) and of red lead (p. 451) has not been indicated.

The book, which is primarily intended to meet the requirements in inorganic chemistry of the school certificate examination in England, would be useful as a text-book for the intermediate examination of Indian universities.

B. S. RAO.

Intermediate Electricity. By R. W. Hutchinson, M.Sc. (University Tutorial Press, London), 1941. Pp. viii + 628. Price 12*sh.* 6*d.*

This is a thoroughly rewritten version of the well-known "Intermediate Text-book of Electricity and Magnetism" by the same author. The Tutorial Press series has been a favourite with students, particularly those depending on private study. In all the books of the series, the full details of every step and every deduction are always brought home to the learner by being presented in a variety of ways. In fact this insistence, this anxiety to drive home the explanation is sometimes carried to such an extent that the more intelligent students might find a certain sense of inelegance and boredom attending a perusal of the entire book. In keeping with the same spirit of oversimplification, the use of the calculus is eschewed or minimised and even in the case of trigonometric and algebraic work there is more of wordy explanation than symbolic derivation. But on the other hand practical and everyday applications and examples likely to appeal to the experience of students are plentifully introduced and illustrated. These characteristics of the series are fully retained in this new version of the book, but the format, illustrations and typography have been very much improved. The author has also tried to develop the subject *ab initio* in a modern manner, the planetary model of the atom being introduced at the very outset. Modern developments having a bearing on practical life, such as Television, High Voltage Generators, the Grid System of Distribution, and so on, are touched upon in such a manner as to make the fundamental principles easily intelligible. Portraits of the pioneers in the subject are interspersed throughout the book and some highly interesting photographs form full-page illustrations. Questions are collected together at the end and answers supplied. Almost all topics in electricity and magnetism usually included in the Pass Degree courses of Indian universities have been included, but the treatment is not advanced enough to satisfy all the requirements of such a course. Though the standard of difficulty is well within the attainments of Intermediate students, it would not be possible to include all the portions here dealt with in an Intermediate course of two years unless more hours are devoted to physics than it has so far been possible to do. Thus the book does not exactly satisfy the needs of Intermediate or B.Sc. students, but falls in between. The get-up is now very much better than before and if some details are omitted, or if some more mathematics is supplied, both Intermediate and Pass Degree students can use the book with a good chance of obtaining a clear grasp of the essentials of the subject. T. S. S.

Galois Lectures No. V. By J. Douglas P. Franklin, C. J. Keyser, L. Infeld. (*Scripta Mathematica,* New York), 1941. Pp. 124. Price \$1·25.

This excellent booklet of 124 pages consists of four lectures delivered by eminent mathematicians at the Galois Institute of Mathematics, Long Island University, Brooklyn. These lectures appeared from time to time in the journal *Scripta Mathematica.* The first lecture is a survey of the theories of integration by J. Douglas, the prover of the Plateaux Problem. It is a very well-written and readable article which develops the theory of integration starting from the elementary area concept to that of Denjoy integration, explaining the significance of the various theories. The article is well worth perusal even by applied mathematicians—Engineers, Physicists, etc. The second is on the *simplest unsolved problem* in mathematics, *viz.,* "The Four-Colour Problem" by Franklin, one of the best workers in this field. The author deals with connected problems such as those concerning graphs and gives the usual proof of the fact that five colours are always sufficient to colour any map however complicated it is. The third lecture by Keyser is on the life of Charles Pierce, a pioneer of the teaching and development of mathematics in America in the latter half of the last century. The fourth is by Infeld on the "Fourth Dimension and Relativity", which is written in the form of a dialogue between a relativist with a clever pupil or a scientist with minimum mathematical equipment. A reading of this article by a non-mathematician will dispel many of the wrong notions commonly held by him about relativity and the *reality* of the fourth dimension space associated with it.

The publishers of the *Scripta Mathematica* deserve the gratitude of the mathematical world for publishing this series in bound form. We await the publication of the other numbers of the series with interest.

K. V.

Burnt Clay or Surkhi as Pozzolana. By C. A. R. Khan and Lal C. Verman. (*Bulletin No. 24 of Indian Industrial Research.*) (Manager of Publications, Delhi), 1941. Pp. 53. Price Rs. 1–6 or *2sh.*

Pozzolanas are materials which easily react with fat lime at ordinary temperatures to form cementatious products in the presence of water or water vapour. Though Portland cement to-day forms the bulk of the cementing materials used in the building trade, surkhi and similar pozzolanas still hold their own both in this country and abroad in many fields of application when a really good hydraulic mortar is required. There are many factors besides the firing temperature which influence the quality of a pozzolana mortar, such as the chemical composition of the original clays, time of maturing, grain size distribution, etc. Khan and Verman have carried out a comprehensive investigation on these properties and their correlations starting with surkhis prepared from clays found in the vicinity of Calcutta. Thus it is found, among others, that high magnesium lime gives stronger mortars than high calcium lime, while increase in iron and aluminium content appears to reduce the tensile strength. Over-burnt surkhi is superior by 25 per cent. and underburnt surkhi is inferior by 14 per cent. on the average to well-burnt surkhi, at long periods of maturing.

A rather strange empirical relationship has been drawn between the tensile strength S (lbs. per sq. inch.), and the time of maturing T (days); this is designed as a "log-log relationship" but expressed as $S = K \log_e \log_e aT$, where "K is a constant denoting the slope of the straight portions of curves and a is a constant determining the position of the curves"!

M. A. G. RAU.

The Nutritive Value of Indian Foods and the Planning of Satisfactory Diets.

The third edition of this well-known and widely circulated Health Bulletin No. 23, issued under the authority of the Nutrition Research Laboratories of Coonoor, has recently been published. The Bulletin has the merit of reminding a starving nation that milk and fruits and pulses and fats, enrich the diet and balance its composition. The planning of a satisfactory diet is one of economics and as the Bulletin points out, it is difficult, in fact impossible, to supply a really satisfactory diet for a nation whose average income is crushingly low. Has the country been producing a sufficient quantity of the vitaminic and protective foods to render them available to the poorest citizen of the country? The agricultural economy of the country should, in the first instance, be directed to keep the nation well fed.

It is pertinent to recall what Sir John Orr has recently pronounced in this connection: "The right of every individual to the means of attaining his full inherited capacity for health and physical fitness, should rank equal with his right to religious and political freedom. In actual fact, children born of poor parents in poor districts are of poorer physique, suffer more from disease and have a lower expectation of life than children born of well-to-do parents. There is evidence to warrant the assumption that inadequate diet is the main cause of this grave social injustice. If we are going to plan for human welfare, we should begin with a food policy based on nutritional needs. This would do more to promote health and happiness, and alleviate the worst effects of poverty, than any other measure. If every family knew that, under any circumstances, they would have sufficient of the right kind of food to give their children full opportunity for the enjoyment of a healthy life, the worst fear of want would be eliminated.

"A food policy based on human needs would involve a great increase in agricultural production. It is estimated that, to bring the diet of the United States up to the standard for health, there would need to be an increase in the consumption of the five most important health foods by the following amounts: butter 15 per cent., milk 20, eggs 35, fruit 70, vegetables 100. Even larger increases are needed in most other countries. The need for increased production would bring prosperity to agriculture. For many years ahead, there would be no fear of any slump in agriculture due to over-production of food."

President Roosevelt has proclaimed "freedom from want" as one of fundamental freedoms of man. May we not hope that the termination of the present conflict will also witness a termination of the appalling conditions of starvation which are so acute in this unfortunate country.

MARKETING IN INDIA

(1) *Report on the Marketing of Rice in India and Burma.* (Manager of Publications, Delhi), 1941. Pp. 626. Price Re. 1-4.
(2) *Report on the Marketing of Groundnuts in India and Burma.* (Manager of Publications, Delhi), 1941. Pp. 446. Price Re. 1-4.
(3) *Report on the Marketing of Potatoes in India and Burma* (abridged edition). (Manager of Publications, Delhi), 1941. Pp. 78. Price As. 8.
(4) *Report on the Marketing of Jute in India and Burma.* (Indian Central Jute Committee, Calcutta), 1941. Pp. 301. Price Rs. 2-8.

RICE

(1) A handy authoritative reference book on the marketing of rice in India and Burma has been a long-felt need. The monograph of the Agricultural Marketing Adviser fulfils the need. Almost every aspect of the problem of marketing of rice has been considered in this volume. Each chapter contains a wealth of details and recommendations which will be very useful to the student, the trader in rice, the reformer and the politician.

The first chapter dealing with the supply side of rice gives an interesting history of paddy culture and a clear analysis of the different seasons for sowing, harvesting and marketing in various provinces of India and Burma. It also gives a valuable account of the different varieties of rice grown in the country. The chapter lays stress on the inadequacy of our rice supply to feed our growing population and on our regrettable dependence on foreign imports of rice.

The second chapter on "Utilisation and Demand" gives an evaluation of paddy and rice utilised for different purposes such as sowing, stock-feeding, manufacturing into products (*e.g.*, murmura, keel, chura) for industrial uses, for export and by far the most important of all, for domestic consumption.

The third chapter under the caption "Wholesale Prices" begins by stating that Indian prices are entirely uninfluenced by world price trends and that even within the country there is no such thing as an average price of rice. It also points out the woeful lack of organisation for the sale of paddy in comparison with that of the relatively organised market for rice. After enumerating the methods devised by the Government for the speedy dissemination of market news for the agriculturist through the radio and the press, the chapter gives a resume of the working of the Agricultural Produce (Grading and Marking) Act and of the pushing into wider use the AGMARK grades.

In Burma, there is not much disparity between the paddy prices and rice prices except for some premiums paid for old crops and for "boat" paddy coming from riverain tracts. The only disruptive tendency in Burma is the dealing in "futures" which instead of levelling seasonal fluctuations in prices aggravates them.

The succeeding three chapters deal in great detail with the preparation of rice for the market, assembling and classification, grading and standardisation. Rice passes through a long array of middlemen. In this process of assembling the produce and distributing it, as the chapter points out, there are involved much wastage of effort, unnecessary payments and the heavy economic loss resulting from the profiteering of a vast number of middlemen by which the actual price got by the grower for his produce is greatly depressed. The trade in rice is carried on only through a visual examination of samples of paddy and the rice contents of samples. This rough method is highly unsatisfactory. So the chapter lays it conclusively that full use should be made of the Agricultural Produce (Grading and Marking) Act, 1937, and the produce should be graded according to the specifications of the Act.

The next four chapters on "Conservation", "Handling and Transportation", "Wholesale Distribution" and "Manufacturing and Distribution of Rice Products" apart from dealing with the respective topics exhaustively, offer some valuable recommendations. For the bulk-storage of paddy it is recommended that growers in particular areas should by co-operation start central storage and marketing societies and thereby gain an extra-profit by selling stored grains only at the end of the seasonal glut. The greatest single addition to the marketing charge of rice comes under the head "freights" and any reduction of transport charges will not only expand the market for the grower in different regions but will confer a real benefit to the consumer. The operation of the "flat rate principle of rates" and "the telescopic scale of rates" in

the railways have not in any way substantially reduced the handicaps in the marketing of rice. A planned and drastic reduction of rates can alone minimise the handicaps. In the distributive trade of rice there exists a host of intermediaries between the grower and the consumer. The chapter does well in pleading for "a proper system of marketing and for a more direct participation in the marketing process by the grower himself."

In India, about 5·7 per cent. of the total crop production (2·41 million tons) is utilised for seed. Such a large utilisation of grains for seeds is due to faulty seed selection and faulty methods of cultivation. The eleventh chapter draws our attention to the immense good that can come about by the Agricultural Departments popularising the use of seeds of improved high-yielding strains. The absurd multiplicity of weights and measures current in the country leads to a good deal of foul play. The recommendations made in chapter XII favour the strict enforcement of the Standard of Weights Act, 1939, in the provinces and the adoption of the Imperial gallon as the standard of dry measure at least in wholesale transactions.

Wherever possible, explanatory diagrams and photographs are given. The appendices supply statistical data and information about the marketing acts in the country and practices obtaining elsewhere. The volume is a welcome addition to the long list of publications which the Agricultural Marketing Department has to its credit.

GROUNDNUTS

(2) Among the groundnut producing countries of the world India tops the list both in the area under groundnut cultivation and in the quantity produced. The average acreage and production during 1933 to 1937 were 7 million acres (36 per cent. of the world acreage) and 2·82 million tons, (34 per cent. of the world production). About 40 per cent. of the total production enter into international trade. India ranks first in the export of groundnut kernels and the average value of exports during 1933–34 to 1937–38 was 11 crores of rupees. Hence the importance of the study on marketing of this cash crop.

The first chapter contains a description of the chief varieties of groundnuts grown in India, the sowing, harvesting and marketing seasons of the crop and the outlets for the surplus kernels and oil-cake. According to the second chapter, the actual quantity of the produce demanded is necessarily regulated by the relative prices of vegetable oils, animal fats and margarine and also by the size of the Indian crop. In the chapter on 'Prices' we find that the Indian producer is unable to reap the full benefit of the higher prices paid for his produce in the international trade due to the intervention of a host of intermediaries and the want of adequate marketing intelligence. Apart from these the essentials for better marketing are conspicuous by their absence. Besides promoting regulated markets, the establishment of organised trading in 'futures' in the chief ports exporting groundnuts will smooth out price fluctuations and give further security to the primary producers.

The chapter on the 'Preparation for Market' convinces us that a little more care given to the harvesting of the crop at the right time, and the decortication of groundnuts by machines instead of by the hand with the help of mallets and sticks will help to fetch higher price for the crops. In the chapter on 'Assembling' we come across all the shortcomings familiar to the Indian market in agricultural produce. Regulated markets and co-operative credit and sale societies, according to the Report, will mitigate these evils. The internal consumption of groundnuts is fast increasing, yet no organised trade bodies have been evolved to look after the interests either of the primary producers or of the sellers at the crushing centres.

The Report further deals with the 'grading standardisation' of groundnuts. The Report shows that the fatty acids, ordinarily found in Indian kernels, can be appreciably reduced by improved decortication, reduction of moisture, harvesting the crop when it is fully ripe and better storage. Freeing the kernels from impurities such as shells, nooks and broken kernels and castor seeds will also ensure better prices. If the grading of groundnuts is done according to the Agricultural Produce (Grading and Marking) Act, 1939, we can look forward to a bright future for the Indian producer of groundnuts. Storage of groundnuts has never been a great problem because storage for more than a year results in the deterioration of the kernels, and storage is also very risky on account of the wide price fluctuations which prevail in the trade.

The railway rates for groundnuts are higher than that for other oilseeds, and

the Report pleads for a revision of rates. If the railway is to hold its own position against cheaper motor transport and be of substantial benefit to the producers, the rates for the transport of groundnut should be the same as those for other oilseeds and there should be no discrimination shown against groundnuts.

It is mentioned that the export of groundnut oil to the foreign markets has got a great future. The Government must facilitate rapid progress by starting grading centres for oils and kernels. Our internal market can be vastly improved by making Vanaspati popular and by using groundnut oil for producing lubricants. The Report also warns us against looking with disfavour upon the crushing of groundnuts by 'chekkus' because the oil produced by this process has a premium over oil produced by mills. There is also much scope for the expansion of the use of groundnut cakes for feeding cattle and for manuring. Here again, heavy transport charges and the prejudices of consumers stand in the way of rapid progress.

The Report advances a case for a regional planning for growing different varieties of groundnuts according to the characteristics of different soils and climatic conditions and suited to the purpose for which the crops are raised. The distribution of better varieties of seed and the dissemination of the knowledge of scientific groundnut cultivation will go a long way towards increasing the yield per acre.

The curse of marketing in India is the use of a diversity of weights and measures. The sooner the Standard of Weights Act, 1939, is brought into force the better. The Imperial gallon is now used for measuring kerosene oil and its use as the basis of a provincial dry measure will be a welcome change.

The statistical data, the graphs and plates in the Report help to give a clear understanding of the problems concerning the marketing of groundnuts. We feel, however, that, instead of giving at the end of each chapter the conditions obtaining in Burma, a separate section could have been included dealing exclusively with the production and marketing of groundnuts in Burma.

The Indian consumption of groundnut oil has increased from 40 to 70 per cent. while exports have fallen from 55 per cent. to about 25 per cent. of the total production. The present time is opportune for India to develop her groundnut crushing industry and the manufacture out of groundnut oil products like Vanaspati and lubricants. After the war, the export of raw groundnut kernels should be forbidden and encouragement should be given to the export of oil, oil-cakes and finished products. The recommendations of the Report for improving the marketing of groundnuts will be of immense use to agriculturists as well as to traders.

POTATOES

(3) Though the potato is not indigenous to India its cultivation as a vegetable has grown in importance in the course of a century. The average area under potato crop in India for the five years ending 1939 is estimated at 448,700 acres, which is about 1 per cent. of the world acreage. The Indian production is about 1 per cent. of the world production and the annual imports of potato, about 11½ lakhs maunds in recent years, are mainly for seed purposes and for meeting the seasonal shortages in supply.

The first chapter gives an account of the share of different provinces of India in the cultivation of potatoes, the area under winter and summer crops and the different varieties grown in the country. In the following chapter on demand, we find that the demand for potatoes in India is mainly for table purposes and that there is not much scope for the expansion of the use of potatoes for industrial purposes so long as rice is an economical substitute. In the chapter on 'prices' it is said that special researches about the storing of potatoes and the dissemination of market news through the radio can effectively offset the seasonal fluctuations in prices.

The Report is informative about harvesting and preparing of potatoes for the market and describes the gains that can be made by grading potatoes according to AGMARK specifications. It also deals at length with the various methods of storing potatoes. It points out the comparative advantages of the cold storage process and emphasises the need for a widespread use of cold storage facilities as the only way of regulating supplies and prices. Only potatoes intended for seeds can be preserved this way because they alone can bear such high cost of storage. The Report states that the damage of potatoes in transit can be considerably reduced by better packing and by the use of wooden waggons in place of steel waggons now supplied by railways for the transport of potatoes. Besides, attempts

should be made to check the power of monopolistic transport concerns fixing arbitrary rates for the transport of potato crop. The chapter on seed deals at length with the defects of faulty seed selection and assures us that the grading of seeds according to AGMARK rules will enable the grower to rely on the seeds he purchases. The chapter on the finance of the potato grower advances a plea for the starting of multipurpose co-operative societies which will supply the grower with all the help he needs, *e.g.*, finance, improved seed, improved implements, market information, grading and marketing of the produce. Incidentally, it advocates the view that producers' associations and traders' associations can protect the respective groups from the inroads of outside vested interests. Besides this, it emphasises the need for research work for evolving a high starch-yielding variety for industrial uses and of a type of potato with short dormancy periods which will obviate the necessity of storing for long periods under the climatic conditions peculiar to India.

The Report will undoubtedly stimulate the desire among the growers, traders and commission agents to reorganise the potato marketing on the lines recommended by it. The present market for potato is capable of great expansion provided healthy propaganda is undertaken. The Report will be more exhaustive if some practical suggestions for market expansion are also incorporated in it.

JUTE

(4) The jute industry plays an important part in the economy of Bengal and the adjoining provinces such as Assam and Orissa. The Second Report of the Indian Central Jute Committee has dealt in detail in this comprehensive volume with the development of the industry in Bengal from the position of a cottage industry to that of a large-scale industry supplying the world's demand for gunnies, hessian and other jute products. The Report throws much light on the working of the Mill Owners' Association, the Brokers' Association and the tribunal set up for arbitration of complaints from buyers about the goods bought.

The first chapter gives a historical account of the development of the jute manufacturing industry in India and other countries. In the second chapter we find that the Indian industry is controlled by a group of managing agents and that the prosperity of many other industries such as coal mining, railway and steamer services, the steel and iron industries, etc., is dependent on the prosperity of the jute industry. The third chapter gives details of the internal organisation of the jute mills and the process of manufacture. The chapter on the 'Marketing of Jute Products' gives a critical account of the part played by speculative dealers, bazaar dealers, brokers and shippers in the sale and export of jute products. It further deals with the factors governing the consumption of jute products. The succeeding two chapters deal with the export trade of jute and the organisation of the export trade.

The Report concludes with a chapter on the trend of wholesale prices of jute and jute products during the decade 1930-40. This chapter enumerates a number of causes that may influence the wholesale prices of jute. The manner in which the prices react to stray events such as the sinking of a ship with a cargo of jute, to political developments, to rumours, etc., establishes beyond doubt that the jute market is highly organised and sensitive even though speculators often exploit it by their operations in the stock exchange. The section on 'Future Prices' analyses the factors that regulate the spot prices and future prices, anticipated supply and demand for a commodity in the future and its relation to the present supply and demand, the buyers' preference for spot commodities and the 'carrying costs'. As the Report itself mentions, the future market often becomes unbalanced owing to the operation of 'buyers who are not genuine merchants working for trading profits, but speculators actuated by gambling motives'.

The Report draws pointed attention to the dearth of statistics about the internal consumption of jute goods in India, and it pleads for the collection of statistics about the actual and potential home requirements for jute products. The foreign demand for Indian jute is for goods of superior quality and hence it will be highly profitable to cultivate superior qualities such as Tossa jute.

The Report is the result of the enquiry inaugurated by the Indian Central Jute Committee. The authoritative and useful information packed in the Report bears testimony to the excellence of the enquiry.

B. V. NARAYANASWAMY.

THE FISHERIES OF THE UNION OF SOUTH AFRICA*

THE Eighteenth Annual Report of the Fisheries of the Union of South Africa shows clearly how the activities of the Department of Fisheries have been influenced by the war. R.S. "Africana" was continuously employed in connection with Seaward Defence, and the normal survey operations were carried out only by the P.B. "Impala". Although investigations were conducted over a large area of the West Coast from Cape Point to Groen River, certain areas such as the Second Salt River Mouth-Blaauwberg and Dassan Island, had to be excluded. Detailed statements of crawfish hauls showing size, sex, maturity, nature of shell, etc., for the various areas surveyed, show a satisfactory maintenance of crawfish supplies. It is thus clear that the existing sanctuaries are sufficient for replenishing the surrounding areas which are being depleted through regular fishing. Owing to certain trawlers being still engaged in Defence Work, deep sea fishing activities were materially reduced, but the richness of the catches enabled large-scale canning to be undertaken, especially for military purposes. Adequate statistics of inshore fisheries are lacking, but it is reported that Snoeak, the chief line-fish, yielded better catches than in the previous year. The census of fishing craft shows a total of 1,864 boats; 1,385 of the rowing and sail type, 458 motor and 21 steam, costing in all £472,719, fitted with gear costing £23,673.

Reduction in shipping facilities and defective canning of frozen tails materially affected the crawfish industry, but it is hoped that the new Export Control Act will make it possible to standardize the commodity and improve the sales organization. It may be noted that three special harbours at Hermanus, Gansbaai and Port Alfred are being constructed for the landing of fish, while steady revenue has been forthcoming from the existing harbours at Lamberts Bay, Gordons Bay and Hout Bay.

A landmark in the history of the Union Fisheries was the transfer of the establishment to the new headquarters at Sea Point. The illustrated description of the Aquarium reveals its up-to-date construction and unique design. In less than one month nearly 12,000 visitors were registered. With its high recreatory and educative value the Aquarium will become one of the most popular attractions of the area.

The Union Government have been quite alive to the needs of proper fisheries legislation. Besides passing the Crawfish Export Control Act No. 9, the Sea Fisheries Act No. 10 was enacted whereby all fishing and whaling in the territorial and extra-territorial waters have been centralised under the Union control. The enforcement of these acts is sure to lead to a smoother working and development of the fisheries.

Research activities have been greatly handicapped by the employment of the fisheries staff for War Service. However, experiments in the artificial rearing of crawfish and sharks, analyses of survey results to ascertain fluctuations in the crawfish fishery, and experiments in rapid freezing of crawfish tails are some of the works in progress.

The authorities are to be congratulated on the maintenance of a high level of efficiency despite the fact that more than two-thirds of the staff are at present on active military service. The achievements of the depleted Department illustrates how even in these abnormal days, fisheries can usefully be utilized for the supply of an item of food which is as valuable for the successful prosecution of war as it is for feeding the population of the Union during peace time.

T. J. JOB.

* *Off. Jour. Dept. Comm. & Indust., Union S. Africa*, 1941, **4**, No. 4, 167–180.

INDIAN ACADEMY OF SCIENCES

THE seventh annual meeting of the Indian Academy of Sciences was held at Nagpur from the 24th to 26th December 1941. The session was inaugurated by Lt.-Col. T. J. Kedar, Vice-Chancellor of the Nagpur University. A message of appreciation of the Academy's work received from His Excellency the Governor of C.P. and Berar, was also read. Sir C. V. Raman then delivered his Presidential Address. In the course of his address he emphasised the role of Academies in national life and their relation to the Universities and appealed for generous help from the governments and university bodies to sustain and enrich the activities of these scientific institutions. He then gave a popular account of the 'New Concepts of the Solid State', developed by him and his students at Bangalore and published in the *Proceedings* of the Academy in the course of the year under review.

There were four popular lectures during the session. Sir C. V. Raman delivered a lecture on the 'Game of Chance', Dr. K. R. Ramanathan on 'Some Problems of Upper Atmosphere', Dr. H. J. Bhabha on 'Recent Advances in Cosmic Ray Physics', and Mr. K. P. Sagreiya on 'Beautiful Trees and their Culture'. Fifty original papers were presented to the sectional meetings. Of these ten were read and discussed.

A useful and interesting symposium on the 'Industrial Development of C.P. and Berar' was held on 26th December. The opening speech was made by Mr. K. D. Guha, the Director of Industries. Ten papers were contributed to the symposium. They dealt with such varied problems as 'Economic Planning for Industrial Development', 'Fodder and Grazing Resources', 'Mineral Resources', 'Production and Distribution of Hydro-electric Power', 'Linseed Fibre Industry', 'Ceramics and Glass', 'Orange Industry', etc., with special reference to local

conditions. The reading of papers was followed by lively discussions. Sir C. V. Raman in winding up the symposium urged for rightful balance being maintained between basic and applied sciences, on which largely depends the success of any scheme of industrialisation of the State.

The following were elected as Fellows: (1) Dr. Norman Loftus Bor, Dehra Dun; (2) Dr. D. V. Gogate, Baroda; (3) Dr. M. B. Lal, Lucknow; (4) Dr. K. L. Moudgil, Trivandrum; (5) Dr. Samuel, Wanleswadi, (6) Dr. N. G. Shabde, Nagpur; (7) Mr. N. A. Shastri, Nagpur, and (8) Dr. H. Subramani Aiyar, Trivandrum.

NATIONAL INSTITUTE OF SCIENCES OF INDIA

THE seventh annual general meeting of the Institute was held at Baroda on January 1, 1942, with Dr. Baini Prasad in the chair.

In his presidential address Dr. Prasad dealt with the zoogeography of India. Wallace, Huxley, Sclater, Sharp, Heilprin and other early workers have attempted to divide the surface of the earth into zoogeographical regions mainly based on the distribution of the present-day groups of animals with only casual references to their geological history. It is clear from their classification that no one scheme can serve equally for all groups of animals.

As Blanford has pointed out, India surpasses in interest all other regions from the standpoint of zoological distribution. The variety in elevation and of climate of this country is remarkable. Peninsular India is a land of great geological antiquity since there has been no evidence to show that it has ever been submerged under the sea. It has been found really difficult to include the whole of India into one natural zoogeographical region since the greater part of Punjab and Western Himalayas undoubtedly belong to the Palæarctic Region rather than the Indo-Malayan Region.

India is a heterogeneous country with diverse types of fauna and this aspect makes the division of India into subregions a difficult task. The affinities of the faunas of different areas are very complicated. Attempts have been made to divide India into subregions by several workers such as Jerdon, Gunther, Blanford, Wallace, Newton, Gadow, Alcock, Annandale, Prashad, Malcolm Smith and Mahendra, generally based on the distribution of the animals studied by them. These attempts for the division of India have not materially helped much in the proper understanding of the origin, distribution and relationships of the various groups of animals.

Dr. Baini Prashad then gave a brief outline of his scheme of the division of India into the following sub-regions: (1) Western Frontier Territory including Baluchistan, the North-Western Frontier Province and the greater part of the Punjab; (2) the Himalayas consisting of the Upper Indus Valley with Ladak, Gilgit, etc., the Western Himalayas from Hazara to the western limit of Nepal, and the Eastern Himalayas from the limit of the Western Himalayas to the Mishmi Hills above the Assam Valley; (3) Assam and Burma comprising the greater part of the Lower Brahmaputra Drainage System and the Burmese territory including Tenasserim; (4) the Gangetic Plain to the east of Delhi, and including the whole of the United Provinces, Bengal, and parts of Assam up to the base of the Assam Hills, together with the plain of the Brahmaputra as far as Goalpara and Cachar, Sylhet and the plains of Tipperah; and (5) Peninsular India, with the Malabar zone as a very distinct subdivision, and Ceylon. A short account of some of the palæogeographic facts about the origin of the Indian fauna has also been given.

The following papers were read at the meeting:

C. V. KRISHNA IYENGAR *Development of embryo-sac and endosperm-haustoria in* Tetranema mexicana *Benth. and* Verbascum thapsum *Linn.* P. K. SEN-CHOWDHURY: *Radio-activity of rubidium.* P. K. SEN-CHOWDHURY: *On the existence of an isotope of cobalt,* Co^{57}. J. DHAR AND B. B. NIYOGI: *X-ray studies in Indian coals. Part I.* V. PURI: *Studies in floral anatomy II. Floral anatomy of the moringaceæ with special reference to gynæceum constitution.* B. N. SINGH AND A. G. CHOWDRI: *The relation of gas pressure to radiation pressure in a Bose-Einstein gas.* B. MOHAN: *Properties of a confluent hyper-geometric function.* D. S. KOTHARI AND F. C. AULUCK: *Degenerate gas and the motion of a particle in a uniform field.* D. S. KOTHARI AND F. C. AULUCK: *Fermi-Dirac and Bose-Einstein gas in a uniform field of force.* F. C. AULUCK: *White dwarf and harmonic oscillator.* H. R. SARNA, P. L. KAPUR AND CHARANJIT: *Studies on helium-filled Geiger-Müller counters.*

The following were elected Office-bearers and other Council Members for the year 1942:

President: Dr. B. Prashad; *Vice-Presidents*: Prof. J. N. Mukherjee and Dr. C. W. B. Normand; *Treasurer*: Dr. B. S. Guha; *Foreign Secretary*: Dr. J. C. Ghosh; *Secretaries*: Prof. S. P. Agharkar and Dr. C. S. Fox; *Members of Council*: Rai Bahadur Dr. K. N. Bagchi, Sir S. S. Bhatnagar, Dr. F. H. Gravely, Dr. S. L. Hora, Dr. M. Ishaq, Dr. D. S. Kothari, Dr. M. S. Krishnan, Prof. G. Matthai, Prof. V. V. Narlikar, Principal G. R. Paranjpe, Principal P. Parija, Dr. F. G. Percival, Prof. M. Qureshi, Dr. K. R. Ramanathan, Rao Bahadur G. N. Rangaswami Ayyangar, Prof. M. R. Siddiqi, Dr. N. K. Sur and Mr. F. Ware.

THE INDIAN STATISTICAL CONFERENCE, BARODA, 1942

THE Indian Statistical Conference held its fifth session at Baroda from the 3rd to the 6th January 1942. As in previous sessions, the Conference was conducted this year in co-operation with the Indian Science Congress. It will be remembered that the Statistical Conference owes its origin to and is still organised by the Indian Statistical Institute which functions with a research staff at the Statistical Laboratory, Presidency College, Calcutta, and has branches at Bombay, Poona, Mysore, Madras, Lucknow and Lahore. The first session of the Conference (Calcutta, 1938) was presided over by Prof. R. A. Fisher of the University of London. Subsequent sessions were held at Lahore (1939), Madras and Mysore (1940), and Benares (1941). The Statistical Conference now provides an annual meeting-ground for those engaged in statistical research in this country, as well as for administrators and others interested in the collection and interpretation of statistics.

The session was opened by H. H. the Maharaja Gaekwad of Baroda on the 3rd January 1942. In his address Sir T. Vijayaraghavacharya, the General President of the Conference, dwelt on the application of statistical methods in Agriculture. The importance of statistical methods was realised by the Imperial Council of Agricultural Research, when in the very first year of its existence, an examination of the manurial experiments made by the agricultural departments in the past revealed that the bulk of the enormous number of experiments that had been performed, yielded no results of general value as they were not statistically valid. The experiments were conducted under conditions which made it impossible to draw from them inferences applicable to other fields. The Council had now laid down a rule that all applications for grants for agricultural schemes from Provincial Departments of Agriculture should be accompanied by information regarding the proposed design and layout of the experiments for scrutiny by the Council's statisticians.

In the matter of collection of Agricultural statistics the method of random sampling survey, Sir T. Vijayaraghavacharya went on, was being employed with success. The fundamental principle of the random sampling process was that every unit in the aggregate should have an equal chance of being included in the enquiry. By means of the mathematical theory of probability it was possible to calculate the margin of error in the sampling estimate. The inaccuracy of statistics relating to forecasts was notorious. The yield of a crop in any given year was the product of three factors, namely, the area under the crop, the normal yield per acre and the season factor. There was much confusion even among officers in the superior grades in the matter of the anna valuation of a year crop. The determination of the per acre yield was a difficult problem which was now being tackled with the help of methods developed by the Statistical Laboratory, Calcutta.

Prof. P. C. Mahalanobis speaking on behalf of the Indian Statistical Institute gave a brief review of the work of the Institute. Among a large number of applied projects carried out during the current year, special mention was made of a new development in the application of the Sample Survey method, namely the "Sample Survey of Public Preference". Several such sample surveys had been carried out recently among middle class Indian families living in Calcutta. A large variety of questions were dealt with, political, social, religious and cultural. To take a few concrete examples of an uncontroversial nature, very interesting and valuable information was obtained on the habits of going to cinema, listening to the radio, preferences in music, interest in Astrology and Palmistry and on social questions like widow remarriage, inter-caste marriages, marriages between different communities, and marriages between persons of different nationalities. Used under proper statistical guidance, the sample survey supplied a most flexible and powerful tool for ascertaining public opinion. Its utility was not confined to politics alone. It could also be of great value in framing policies of social reconstruction.

Discussions on the following subjects were held during the session: (1) The use of Factorial and Incomplete Block Designs in Agriculture, (2) Problems of Discrimination, (3) Administrative Statistics, (4) Factor Analysis, (5) Census and Vital Statistics, (6) Teaching of Statistics.

The discussion on Teaching of Statistics was a sequel to a similar discussion held during the fourth session of the Conference held at Benares in 1941. As a result of that discussion a questionnaire dealing with various aspects of the teaching of Statistics had been drawn up and circulated among those interested. The answers received were considered during this session and in the discussion which ensued, university teachers from all parts of India took part.

In addition to the discussions a large number of papers bearing on both theoretical and applied statistics were read at the meeting.

The following resolutions were passed:—

(1) The Indian Statistical Conference welcomes the proposal to inaugurate an Indian Congress of Social Sciences which will hold its session along and in co-operation with the Indian Science Congress and commends this proposal to the Indian Science Congress Association, the Indian Economic Conference, the Indian Association for Agricultural Economics, the Indian Political Science Conference and the Associations and Institutions interested in this matter.

(2) The Indian Statistical Conference recommends to the Government of India: (*a*) the creation in the immediate future, of a standing Advisory Board for the Indian Census to give advice in regard to the technical aspects of census operations; and (*b*) the creation of a permanent Bureau for Census and Vital Statistics.

CENTENARIES

Galilei, Galileo (1564–1642)

GALILEO GALILEI, a famous Italian astronomer, was born at Pisa, February 15, 1564. He was admitted to the school of medicine of the University of Pisa in his 19th year. However he took more interest in mathematics and while studying Archimedes he wrote his paper *Hydrostatic balance*, which secured for him the lecturership in mathematics in his own university in 1589. It was about this time that he gave the celebrated demonstration from the leaning tower of Pisa. In 1592 he became professor of mathematics in the University of Padua, first for a short time and eventually for life. His popularity soon became so great that a hall with a thousand seats was found inadequate for his audience.

In 1609 he constructed his first telescope with a magnifying power of three. In a few months, he constructed one which magnified thirty times. With its aid, he made a series of observations such as (1) the mountains and caves of the moon, (2) forty stars in the Pleiades, (3) the discs of planets, (4) the satellites of Jupiter, (5) Saturn's ring, (6) the phases of Venus, (7) Sun spots, and (8) the rotation of the Sun.

In 1612 he published his *Treatise on floating bodies*. In 1632 he brought out his *Dialogues on the Ptolemaic and Copernican systems*.

Twice he had to face inquisition, first in 1614 and again in 1634 on the charge that he evaded by the publication of his *Dialogues* his promise in 1614 not to support the Copernican theory. This book was proscribed and he was condemned to prison and was ordered to recite once a week the seven penitential psalms! Even to obtain this sentence, Galileo had to abjure, on the Gospels, his belief in the Copernican theory. It is reported that, rising from his knees after his solemn abjuration, he whispered to a friend "It moves for all that."

In 1636 Galileo discovered the diurnal libration of the lunar disc; shortly thereafter he became blind. In 1641 he was just developing the idea of using pendulum in clocks.

Galileo's works were published in thirteen volumes at Milan in 1811. A more complete edition came out at Florence in sixteen volumes in 1858. A national edition was published at Florence in twenty volumes in 1890 *et seq.* A second issue of this edition was commenced in 1929 and completed in 1938.

Galileo had begun a continuation of his *Dialogues* and was occupied with a study of the force of percussion, when he was attacked with fever and palpitation of the heart which, after two months of suffering, terminated fatally January 8, 1642, one year before Newton was born.

S. R. RANGANATHAN.

University Library,
Madras.

SCIENCE NOTES AND NEWS

Neanderthal Man and His Culture in Central Asia.—Information reaches us through American journals of important anthropological and archæological discoveries made by Russian scientists in Southwestern Uzbekistan, not far from the Soviet-Afghan frontier. The excavations were conducted by A. P. Okladnikov under the auspices of the Historical Institute of Material Culture, Leningrad, and the Uzbekistan Committee for the Preservation and Study of Monuments of Material Culture, Tashkent. At the foot of some of the hills of the Guissar Mountain Range there are numerous grottos and caves made by stream action. Mousterian caves were discovered among them in 1938–39, with the characteristic stone and bone implements. The fragmentary skeleton of a child of seven or eight years of age was found in association with the implements. Reconstruction of the skull at the Anthropological Institute in Moscow revealed typical Neanderthaloid features, such as the absence of canine fossæ, prominent teeth, lack of chin, low cranial vault, strongly sloping forehead, pronounced brow-ridges, etc. Among the associated fossil relics were bones of the Siberian goat, leopard and the wild horse. There were also signs of a large bon-fire having been made in connection with some ritual.

The Neanderthal man of Uzbekistan must have been a keen hunter, for the wild goat is a very elusive animal, and in the leopard he would have found a competitor.

To us in India, the discovery of Neanderthal man not far from our frontiers is not without significance. There is every probability that representatives of the Neanderthaloid stock lived in N. India, and a careful survey of caves and rock-shelters in the glaciated regions is now well worth attempting.

A. AIYAPPAN.

Coin Accessions in the Madras Museum.—The composition of the hoards coming into the Museum annually from treasure trove in the province required study before dispersal by distribution to other institutions or by sale, as little progress had been made in establishing the affiliations and the chronology of coins associated in hoards. So, the hoards that came in during the decennium were analysed and studied with respect to their composition and they were not dispersed till some definite results had been attained. The chronology and

the geographical distribution of the different varieties of *panams* have benefited most by this measure of caution; it is now possible to say, with some approach to accuracy, which varieties occur where and when,—which is indeed a great advance considering how ignorant we are about them. The issue of the so-called 'Rajaraja' type of copper seems to have persisted even after the rise of the Setupatis. Certain *varahas* attributed to Krishnadevaraya have to be reassigned as they are found in association with the *varahas* issued by Haidar. The gradualness with which the *varahas* of the East India Companies displaced the various Vijayanagara issues is brought out strikingly, and the efforts of the Companies to improve on the quality of the metal are obvious. From the extent of the wear of the various issues that made up two hoards of Roman gold aurel it was possible to determine the rate at which gold coins became worn in the course of circulation. A new class of die-struck *puranas* came from the vicinity of Jaggayyapetta which seems to mark the transition from the well-known class of punch-marked *puranas* to the much later *varahas* which bear a symbol in the middle and four more along the periphery. A large hoard of silver coins found in the Ramnad District having contained about 125 coins, it was possible to piece various bits of the legends together and to settle that the issue was that of Ravivarman Kulasekhara (*c.* 1316 A.D.), perhaps the most famous of the Kerala rulers of mediæval times.

T. G. A.

The Effect of Organic Dye Ions on the Electrokinetic Potential.—Jordan (*Trans. Faraday Soc.*, 1941, 37, 441) has determined the electric moment of the double layer at the glass-water interface in the presence of five dyestuffs by the streaming potential method. The streaming potential is found to change with time initially attaining a steady state slowly. The rate of flow of the solution was also found to decrease on continuous streaming. The results are interpreted on the basis of the aggregation of the dye at the surface of glass. There is a close correlation between this effect and micelle formation in solution.

K. S. G. D.

Artificial Regeneration of Dry Fuel Forests.—Mr. A. L. Griffith's work on the technique of regenerating the dry fuel crops in the scrub jungles of Madras has already been noticed in *Current Science* (1940, 9, 436). In a recent number of *Indian Forest Records* (New series, 4, *Sylviculture*, No. 4, Delhi, 1941), Mr. Griffith summarises the data of some 222 "small scale" experiments on which his recommendations are based. These experiments are comprehensive in their scope and were designed to provide answers to the questions: how to plant (sow, transplant or stump-plant)? When to plant (the effect of the season in which the seeds are sown, etc.)? What is the best size and age of stumps for planting? And what effect the burning and "working" of the soil has on the resultant crop? The author confirms his earlier conclusions which generally favour direct sowing in late June or early July after the site has been burnt and worked; soil working after germination, while recommended in all cases is considered to be absolutely essential in the case of backward crops. As for stump planting, the experiments indicate that two-year-old stumps planted late in September or early October give optimum results. Thus, Mr. Griffith's work extending over a period of seven years provide the experimental background to an admittedly difficult problem. It is interesting to record that the solutions suggested by the author have evoked considerable interest in the lay press also, the public at long last appreciating the role which these humble scrub jungles do play in providing fire and charcoal for the community. The widespread use of charcoal in internal combustion engines is ultimately directly coupled with the regeneration of the dry forests and this is one more reason for welcoming the lead which Mr. Griffith has given to the solution of regenerating dry fuel forests.

Colourisation of Vegetable Ghee.—The oil-soluble vegetable dye "Kamala" (from *Mallotus philippinensis*) which is available in India and is non-injurious, is suggested by the Forest Research Institute, Dehra Dun, for distinctive colouring of vegetable ghee (hydrogenated fat).

For colouring Vanaspati ghee, to distinguish it from genuine ghee, the Punjab Government recently passed legislation that vanaspati be coloured deep orange and that aniline dye (orange D) be used for the purpose. Besides this dye being unavailable in India, objections to the use of aniline were that its consumption had toxic and cumulative effects.

It was, therefore, proposed by the Institute to the Agricultural Marketing Adviser to the Government of India that Vanaspati ghee may be coloured with the oil-soluble vegetable dye "Kamala" which is stated to be non-injurious in small doses. It is not yet fully established if this vegetable dye has any cumulative effect on the human system and arrangements are being made to have this part of the problem investigated.

The Golgi Apparatus in Protozoa.—Since 1924 when Nassanow announced that the contractile vacuole in Protozoa possessed, in association with it, a substance which reduced osmium tetroxide, and homologised it with the Golgi apparatus of the metazoan cell, many important memoirs on the Golgi apparatus of the Protozoa have appeared, but the position still remains obscure regarding the homology and function of the Golgi apparatus in these lowly organised animals. Much of the recent work on this subject has been done in Prof. J. B. Gatenby's laboratories at Dublin and two recent memoirs on the subject, one by Gatenby himself (*Proc. Roy. Irish Acad.*, 46, Sec. B, 161) and the other by J. D. Smyth (*Proc. Roy. Irish Acad.*, 46, Sec. B, 189) help in clarifying the issues. Working on a number of protozoans belonging to various groups, both the authors come to very similar conclusions regarding the

disposition and possible homology of the Golgi apparatus. In many protozoans the wall of the contractile vacuole reduces osmium tetroxide. In Chilomonas, this wall divides into two when the cell divides and is distributed between the daughter cells. But in a few cases, the original contractile vacuole and cortex remain in one daughter cell while the other cell develops these structures independently.

But the fact of greatest importance that has emerged from these studies is that the osmiophilic material is not always associated with the contractile vacuole but may occur scattered in the cytoplasm and it is this position that is more primitive and more typical. This is shown by the fact that the accumulation of the osmiophilic material around the contractile vacuole is by no means necessary for the functioning of the vacuole. For, in primitive forms like Amœba, Nebela and Arcella, the osmiophilic cortex is not present.

The present position appears to be that the osmiophilic material alone represents the Golgi apparatus and its association with the contractile vacuole is secondary; the two parts must have arisen independently in the evolution of the cell. Regarding the function of the Golgi apparatus in the Protozoa, its association with the contractile vacuole would seem to suggest, at least in those forms where this association exists, a possible relationship with the function of the latter structure. It is now known that the contractile vacuole is osmoregulatory (Zolger, Wolff, Yocom), but the precise relationship, if any, has still to be determined as the evidence now available is conflicting. Further work is needed before any conclusive views can be developed regarding the function of the Golgi apparatus in the Protozoa.

Decapod Larvae from Madras Plankton.—In a publication issued from the Madras Museum (1941), Mr. M. K. Menon has given a systematic account of the larvæ of a number of species belonging to the important families Penaeidæ, Sergestidæ, Hippolytidæ, Alpheidæ and Palæmonidæ of the sub-order Natantia, and Callianassidæ and Porcellanidæ of the sub-order Reptantia under the order Decapoda. Full descriptions of the available stages are given.

Smut Diseases of Wheat are found to cause considerable damage to wheat crop in India, and extensive work has been carried out with good success in combating the disease. The loose smut of wheat caused by *Ustilago Tritici* (Pers.) Rostrup, and *Urocystis Tritici* Koernicke, popularly called the flag smut of wheat are widely distributed in Punjab and United Provinces. *Urocystis Tritici* has a wider distribution extending up to Baluchistan and South Afghanistan. The loose smut of wheat is ovaricolous and the disease is internally seed-borne. Consequently hot water treatment usually adopted for disinfecting the seeds before sowing is not only not practicable but also causes injury to the seeds impairing the viability. The flag smut of wheat is foliicolous and damage is caused only when it appears in epidemic proportions. Seeds harvested from affected plants are found to possess non-viable seeds.

The only effective method of controlling the devastating effects of these two smuts is the breeding of smut-resistant varieties. Comprehensive work carried out in the Mycological Section of the *Imperial Agricultural Research Institute* (B. B. Mundukur and B. P. Pal, *Ind. J. Agri. Sci.*, 11, 675) indicates very promising results. Varieties of wheat including Imperial Pusa 114, 120 and 165, are immune to loose smut, whereas IP. 4 and 111 showed high resistance to flag smut. It has been noticed that varieties of wheat resistant to the loose smut are susceptible to the flag smut. But varieties like Sword, Igachikugo, Dundee and others show a very high degree of resistance to both the smuts. It is well to remember that in selecting a good variety of wheat, importance is attached not only to smut resistance, but also to the economic importance of the particular variety. M. J. T.

Grape Cultivation in India.—With a view to giving in brief the important features of the survey of marketing of grapes in India, the Agricultural Marketing Adviser has published an abridged version of the main report which is expected to be of special interest to fruit-growers and merchants, schools, colleges and agricultural and other institutions connected with rural development work.

The survey holds out the prospect of India trebling the area under grapes thus adding nearly Rs. 70 lakhs to the agricultural income as at present derived from that crop. It is surprising, says the report, that the area and quantity produced in India are so small, particularly as the yield per acre obtained surpasses that in most other grape-growing countries of the world.

In the propagation of vines it is considered desirable that there should be a system of registration of approved nurseries, some of which at present sell stocks which are not genuine. Very little work has been done in classifying existing varieties and in evolving new varieties and types of grapes likely to be more profitable than those under cultivation. It is suggested that at least one or two experimental stations in grape-growing areas might undertake this work.

Meteorological Department, Burma.—Soon after the separation of Burma from India in 1936, an organisation for meteorological work was set up in that country, modelled on the lines adopted by the Meteorological Department of the Government of India. The first report now issued by the Director deals with a period of four years (1937–41) and contains much information of interest regarding the various activities of the department and the arrangements that are available for an efficient weather service for the country. The initial stage is usually the most difficult one, and thanks to the generous help of the India Meteorological Department, it was possible to plan the organization of the service on a scale large enough to cope up with the

responsible duties of the issue of weather forecasts for the use of shipping in Burma waters and for the purposes of aviation over a large tract of country. The main features of the organization are given in the opening chapter together with a brief historical sketch, and Chapters II to IV contain an account of the work done in connection with marine and aviation meteorology and of the arrangements for storm warning, etc. In the fifth chapter there is a detailed description of the work of the Headquarters office at Rangoon, where the administrative and forecasting duties are carried out. The Department maintains two auxiliary centres at the airports at Mingledon and Akyab, four pilot balloon observatories and twenty-nine second class meteorological stations. There are besides 240 raingauge stations co-operating in the rainfall registration of the country. The department has to its credit a record of much useful and substantial work carried out during the period of four years since its foundation.

T. P. B.

Central Revenues, Control Laboratory: (Report of the Chief Chemist, 1939–40).—The most important event recorded in the Report is the transfer of the Control Laboratory to a new building of modern design in New Delhi, fitted with the latest equipment. It is gratifying to note that research work and advisory work for other Government Departments are included in the functions of the Control Laboratory. Among the more important investigations carried out are a scheme submitted to the Central Board of Revenue for carrying out experiments on the industrial use of Gypsum from Khewra, and work on the production of Crystal salt from the East Lake bitterns area at Sambhar. The total number of samples tested during the year was 88,787 as against 65,946 in 1938–39, and 44,937 in 1937–38. It would be seen that the number has doubled within the course of two years. On the whole, the Report is a record of solid and useful, though not spectacular, work.

Indian Forest Ranger College, Dehra Dun.—The progress report of the College for 1940-41 discloses that 35 students were in their second year of training during the year. Of these, all except one were probationers of either Provincial Governments or Indian States; one came from Nepal. Seven students secured the Honours certificates while higher standard certificates were awarded to 28 students. The health, discipline and work of the students were satisfactory. The Director's report says that the Government of India have reviewed the present practice of admitting batches of students once in two years and have decided to make admissions hereafter annually so as to have overlapping classes. The expenditure on the College during the year was Rs. 44,918 and was more than covered by the Revenue of Rs. 50,030 (consisting mainly of the training fees from the students amounting to Rs. 48,750). While there is no question of the high standard of the training at Dehra Dun, this comparatively high cost per student has been one of the grounds on which some foresters advocate the development of regional forestry instruction centres in India.

Indian Central Cotton Committee.—At the meeting of the Indian Central Cotton Committee held on the 24th January 1942, the following resolution moved by Sir Purshotamdas Thakurdas was unanimously carried:—

"In view of the necessity and urgency of avoiding any further glutting of the Indian cotton market with short and fair staple cotton hereafter, the buyers of which have been cut off from the Indian market owing to the present hostilities which may run for a period which cannot be estimated at present, the Indian Central Cotton Committee requests the Government of India to urge all Provincial Governments and States in India, especially those in areas where short and fair staple cotton is being grown, to reduce the existing acreage under such cotton forthwith by at least 50 per cent. As alternative to short and fair staple cotton, such other crops may be encouraged as may suit the conditions of each area, preference being given to food grains, adequate stocks and reserves of which will continue to be a matter of vital national importance for a number of years to come. To stimulate and accelerate such change Provincial Governments and States should be urged to subsidise the same by such means as may be most effective according to local conditions in each Province and State, including the supply of free or cheap seeds and the provision of funds and facilities for the sinking of new and the repair of old wells. The Committee requests every Provincial and State Government concerned to notify the public regarding the action taken by them as early as possible not later than 1st March next."

At the half-yearly meeting held, which concluded its deliberations on the 24th January, several questions of interest to the cotton industry received attention. A sub-committee was appointed to consider the uses to which Indian short staple cotton can be put. The sub-committee which will function in collaboration with the Mill-owners' Association, will consider what work should be taken up immediately and, in particular, will examine the various suggestions made in respect of the use of the short staple cotton for the manufacture of blankets, for mixing for purposes of spinning, for lining of irrigation channels and as regards chemical finishes to cloth made from short staple cotton; the sub-committee will also examine the Cotton Diversion Programme of the U.S.A. and see how far similar methods can be adopted in this country.

The Committee sanctioned a scheme for studying the nutritional values of American type of cotton seed as cattle food. The investigation will be carried out under the guidance of the Director of Agriculture, Punjab.

Indian Ecological Society.—The First Annual General Meeting of the Indian Ecological Society was held at Baroda on 4th January 1942, with Prof. S. P. Agharkar, the President of the Society, in the Chair.

The following were elected Office-bearers of the Society for the year 1942:—

President: Prof. S. P. Agharkar; *Vice-Presidents*: Dr. N. L. Bor and Dr. S. L. Hora; *Hon. Secretary and Treasurer*: Dr. F. R. Bharucha; *Members of the Executive Council*: Mr. P. W. Davis, Mr. E. A. Garland, Prof. P. W. Gideon, Dr. R. Misra, Dr. L. A. Ramdas and Dr. T. S. Sabnis.

The meeting terminated with an address by the President on "The Present Position of Ecological Work in India".

Royal Asiatic Society of Bengal: Dr. C. S. Fox, Director, Geological Survey of India, was elected President of the Society for the year 1942, at the meeting of the Society held on the 2nd February 1942.

The Joy Govind Law Gold Medal of the ROYAL ASIATIC SOCIETY OF BENGAL has been awarded to Dr. K. N. Bahl, D.Phil., D.Sc., F.R.A.S.B., Professor and Head of the Department of Zoology, Lucknow University, for "conspicuously important researches in Zoology in Asia".

University of Calcutta.—

Dr. K. S. Krishnan, D.Sc., F.R.S., has been appointed to the Adharchandra Mookerjee Lectureship for the year 1941. He will deliver a course of lectures on "The Physics of Metals".

The Sir Devaprasad Sarvadhikari Medal for the year 1941 has been awarded to Sir C. V. Raman, Kt., M.A., Ph.D., D.Sc., LL.D., F.R.S., Nobel Laureate, who has signified his acceptance of the same with thanks.

Mysore University.—Mr. E. G. MacAlpine, Director of Public Instruction in Mysore, has been appointed Acting Vice-Chancellor of the Mysore University *vice* Mr. N. S. Subba Rao, M.A., Bar-at-Law, on leave prior to retirement.

Delhi University.—H. E. the Chancellor of the Delhi University has been pleased to appoint the Hon. Mr. N. R. Sarkar to be the Pro-Chancellor of that University for a period of three years with effect from January 31, 1942.

Andhra University.—The Government of India have, on the recommendation of the Indian Medical Council, given recognition to the M.D. and M.S. Degrees of the Andhra University.

Bombay University.—The Registrar of the Bombay University announces that all Examinations of the Bombay University will be held this year *as usual* and that rumours that they are to be postponed are unfounded.

Diploma in Military Studies.—The Senate of the Bombay University has approved the programme to institute a Diploma in Military Studies to be awarded to such persons as have obtained the certificates 'A' and 'B' issued by the Military authorities and have undergone the prescribed course and have passed the qualifying examination for the Diploma. This will enable the University to start the course as soon as conditions permit.

The Government of Bombay have appointed a Committee, with the Rt.-Hon. M. R. Jayakar as Chairman, to investigate and report on the question of a **University for Maharashtra.**

Lucknow University.—The Faculty of Science agreed to the principle of imparting instruction in Science subjects through the medium of the language of the province and appointed a Committee to make proper recommendations. The Committee consisted of the following:

Dr. B. Sahni, F.R.S., *Convener*; Dr. Gorakh Prasad (Allahabad University); Dr. M. R. Siddiqi (Osmania University); Dr. K. N. Bahl (Lucknow University); Dr. S. H. Zaheer (Lucknow University); Dr. S. N. Shukla (Lucknow University); Dr. S. K. Pande (Lucknow University); Dr. K. N. Mathur (Lucknow University); Dr. A. N. Singh (Lucknow University).

It is understood that the recommendations of the Commitee are the following: (1) The principle of imparting instruction in the University in the language of the province be accepted. (2) The medium of instruction and examinations should be Hindustani, which signifies the spoken language of the province supplemented by words taken from Sanskrit, Persian, English and other languages. (3) The script for all scientific work written or published should be Roman, supplemented by new letters and signs wherever necessary. (4) The language of books should be left to the discretion of individual authors. (5) The B.Sc. students appearing in the examinations in 1944 may be permitted to answer questions either in English or in Hindustani written in Roman script at their choice. (6) Teachers are permitted to deliver lectures to the B.Sc. class in Hindustani. (7) The medium of instruction for B.Sc. classes from 1944-45 session shall be Hindustani.

Individual teachers may be permitted in special cases by the Executive Council of the University to deliver lectures in English.

Information has been received from Professor Henry S. Sigerist, Director of the Institute of the History of Medicine of the John Hopkins University, Baltimore, and the Secretary of American Association of the History of Medicine, that Dr. D. V. Subba Reddy, Department of Physiology, Andhra Medical College, Vizagapatam, India, has been elected as a *Corresponding Member* of the **American Association of the History of Medicine.**

Science and the World of To-day.—Since the publication of the article under this title in *Current Science* (Vol. 11, No. 1, pp. 1-3), we have received a copy of the address delivered by Sir T. S. Venkatraman in opening the Science and Arts Exhibition at the Victoria College, Palghat, in October 1941. That Sir T. S. Venkatraman is in substantial agreement with the views contained in the article will become clear from the perusal of the following excerpts:—

"The steadily increasing control which man has been able to obtain over the elements like water and air and various forces of Nature is obvious ...

"It is unfortunate that the advances on the destructive side have been equally great ...

"These opposite results from sets of activities both called 'Scientific' unerringly point to the main case of this disharmony and its solution . . .

"If now science appears to have failed mankind and given us a disjointed world, this has largely resulted from two defects of present-day science and its activities, *viz.*, (1) the lack of harmony between the different sciences and (2) the neglect of what may be called the 'spiritual' side of man and of the great 'humanities'. . . . To my mind the staring defect in present-day advance has been its specialisation and resultant narrowness of vision ignoring the allied sciences. The other defect has been the neglect of the study of man as a human being. We have made extensive studies of man as a machine, but not of man as a spiritual entity. . . .

"The terrible war now in progress and its repurcussions indicate that the future of the world—if there is a future at all—lies in the establishment of greater harmonies between different sciences, between different nations and last but not least, attention to the spiritual values of man. The day-to-day science of to-day is but a step and preparation towards the development of a 'higher, deeper and more harmonious scale'. Its defects include its narrow-mindedness and its over-emphasis on material values. It is to be hoped that events now taking place all over the world will enable man to realize his defects, enlarge his scientific outlook and establish a brotherhood which alone can bring us 'Peace, Contentment and Happiness. . . ."

Sigcol Glassware.—We have received a copy of the new Catalogue of "Sigcol" glassware, dated November 1941, handed over to us by their distributors, MESSRS. ADAIR, DUTT & CO., LTD. It has a brief but attractive introduction and contains a list of some 54 items. The enterprise of Messrs. Scientific Indian Glass Co., Ltd., in introducing a glass suitable for the scientific requirements of the country is now commonly known by nearly every scientist all over India. It is a pleasure to note that several attractive additions have been made and an important contribution is in adding a glass the physical and chemical properties of which correspond to those of other well-known brands of heat resisting glass having a very low co-efficient of expansion. We are sure this will attract the attention of all concerned. For convenience of the users, rubber corks to fit the several types of glassware, have been added. A copy is available on request from the distributors.

ASTRONOMICAL NOTES

The Sun will be at the vernal equinox on March 21 at $11^h\ 30^m$ I.S.T.

Eclipses.—An eclipse of the Moon, visible generally throughout India, will occur on March 3, the circumstances of which are as follows:

	h	*m*	
Moon enters umbra	4	1	a.m. I.S.T.
Middle of Eclipse	5	52	„ „
Moon leaves umbra	7	42	„ „

The magnitude of the eclipse will be 1·567 (taking the Moon's diameter to be equal to 1·0).

On March 16, there will occur a partial eclipse of the Sun; but the phenomenon will not be visible in this country.

Planets during March 1942.—Both Mercury and Venus will be morning stars; the former reaches greatest western elongation from the Sun (27° 21′ W) on March 8, when it will be visible near the eastern horizon for over an hour before sunrise. Venus will attain greatest brilliancy on March 9, the stellar magnitude at the time being —4·3. The four major planets Mars, Jupiter, Saturn and Uranus (all in the constellation Taurus) can be seen in the western sky in the early part of the night. Jupiter will be in quadrature with the Sun on March 3.

T. P. B.

MAGNETIC NOTES

The month of January 1942, was much less disturbed than the preceding month. There were 14 *quiet* days, 16 days of *slight* disturbance and one of *moderate* disturbance during January 1942, as against 9 quiet days, 20 days of slight disturbance and 2 of moderate disturbance during January 1941. The day of the largest disturbance during January 1942, was the 17th and the quietest day was the 21st.

The characteristics of individual days was as follows:

Quiet days	Disturbed days	
	Slight	Moderate
1, 7, 10, 11, 13, 20, 21, 23-26, 30, 31	2-6, 8, 9, 12, 14-16, 19, 22, 27-29	2

During the month no magnetic storms were recorded while one moderate storm was recorded during January 1941. The mean character figure for the month is 0·58 as against 0·77 for January 1941.

M. R. RANGASWAMI.

SEISMOLOGICAL NOTES

During the month of January 1942, three moderate and three slight earthquake shocks were recorded by the Colaba seismographs as against five moderate and six slight ones recorded during the same month in 1941. Details for January 1942 are given in the following table:

Date	Intensity of the shock	Time of origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
January 1942		H.	M.	(Miles)		(Miles)	
18	Slight	22	7	1580			
24	Slight	2	59	3610			
27	Moderate	18	59	5030		280	
29	Slight	14	56	5420			
30	Moderate	17	42	1950	Epicentre in the neighbourhood of north-west Sumatra		
31	Moderate	23	0	2110		110	

ANNOUNCEMENTS

Lady Tata Memorial Trust.—Scientific Research Scholarships, 1942–43.

1. Applications are invited for six Scientific Research Scholarships of the value of Rs. 150 per month each for the year 1942-43.

2. The Scholarships are open to men and women, and will be tenable for a period of twelve months commencing from the 1st July 1942. Any or all the Scholarships may be extended for a further period of twelve months, within the discretion of the Trustees. All old scholars who desire renewal should re-apply.

3. Applicants, who must be of Indian nationality, must be Graduates in Medicine or Science of a recognised University. They must undertake to work whole-time and will be debarred from private practice. In the duration of the period of his scholarship or award the recipient of the benefit shall devote himself to the work before him to the entire satisfaction of the Trustees, who reserve the right to withhold payment on the recommendation of the Advisory Committee.

4. The subject of scientific investigation which they may select must have a bearing directly or indirectly on the alleviation of human suffering from disease.

5. Applications must be forwarded through the Director of a recognised Research Institute or Laboratory where the candidate proposes to work and must be accompanied by a letter from the Director stating that he has critically examined the details of the proposed Research, that he approves of the general plan and that he is willing, as far as possible, to guide and direct the investigation and give laboratory facilities.

6. Applications must be addressed to the Secretary, The Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay, so as to reach him *not later than 15th March* 1942.

Central Sales Branch of the Imperial Agricultural Bureaux.—The following press notice has been received:—Specialists in the various branches of agricultural research and teaching will be interested in a new development in the organization of the Imperial Agricultural Bureaux. Some time ago it was decided that, for the sake of increased efficiency and economy, all work connected with subscriptions, sales, and distribution of the journals and other publications of the majority of the Bureaux should now be centred in one office. For this purpose, a Central Sales Branch has been organized, with its offices at the Agricultural Research Building, Penglais, Aberystwyth. In future all correspondence dealing with sales and distribution should, with the exceptions noted below, be so addressed. Correspondence on all other matters must still be addressed to the Deputy Director of the Bureau in question.

The only publications not dealt with by the Central Sales Branch are those of the Imperial Institute of Entomology (The Assistant Director, Imperial Institute of Entomology, 41 Queen's Gate, London, S.W.7) and the Imperial Mycological Institute (Director, Imperial Mycological Institute, Ferry Lane, Kew, Surrey), and *Nutrition Abstracts and Reviews* (Secretary, Imperial Bureau of Animal Nutrition, Rowett Institute, Bucksburn, Aberdeen).

Manufacture of Internal Combustion Engines.—The Government of India have set up an Exploratory Committee consisting of Mr. J. C. Mahindra (Chairman), Prof. A. Viswanath, Mr. P. F. S. Warren, Dr. M. Ishaq, Mr. J. E. Syrett and Mr. B. D. Basil, to examine the production of components or complete internal combustion engines offering prospects of immediate development with particular reference to war demands and the future development of an internal combustion industry in India.

Suggestions on the manufacture of internal combustion engines, specially by those who have been investigating the problem, may be communicated to the Secretary, Exploratory

Committee on Internal Combustion Engines, Clive Street, Calcutta.

Certain Aspects of Pure and Applied Photochemistry.—The following paragraphs relating to the summary of Prof. Qureshi's address (*vide* Supplement, *Current Science*, January 1942, p. 32) have been inadvertently omitted:—

The greatest achievement of applied photochemistry is the modern art of photography. The recent advances have been mainly the discovery of sensitisers for the infra-red and the discovery of de-sensitisers. The effect of these developments is remarkable. Formerly, plates had to be exposed in sufficiently strong light and developed in the dark. Now, it is possible to expose the plate in the dark and develop it in strong light. On the theoretical side, the mechanism of latent image formation has been satisfactorily interpreted by Gurney and Mott. Their theory gives a satisfactory explanation of several phenomena such as high intensity and low intensity reciprocity failure, Herschel effect and the recent work on the latent image formation at low temperatures.

Photohalogenation is of considerable theoretical and practical importance. The technical aplications have been covered by a number of patents; but only a few have been exploited commercially. Lieser and Ziffer and Snelling have worked out the details for the production of methyl chloride from methane. Geiger and Gibbs and Ellis have described processes for chlorinating the side chain in aromatic compounds. The use of sulphuryl chloride as a chlorinating agent in photohalogenation has been described by Kharash and Brown.

Photopolymerisation again presents a field which may be expected to yield valuable results from the theoretical as well as the practical point of view. The photopolymerisation of acetylene, ethylene, vinyl esters, styrene, isoprene and butadiene has been studied. Several rubber-like products have been isolated.

Photochemical reduction of carbon dioxide has attracted a lot of attention on account of its fundamental importance in the photosynthesis by plants. The earlier attempts to reduce carbon dioxide in aqueous solution by light were made by Usher and Priestley and by Moore and Webster. Baly and co-workers as well as Dhar and co-workers have reported positive results regarding the photo-reduction. But the work of Spoehr, Bauer and Rebmann, Bauer and Büchi, Porter and Ramsperger, Burk, Qureshi and Mohamad, Bell and Scheile has shown that the photo-reduction of carbon-dioxide does not occur under the conditions employed by the former authors.

K. S. G. D.

Indian and Eastern Chemist.—We are informed that owing to unexpected circumstances the Proprietors of this Journal, Messrs. Leonard Hill, Ltd., of London, have decided to discontinue its publication in India, although the Bengal Pharmaceutical Association offered to take over, finance and conduct the Journal as its own official organ.

* * *

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 89, Nos. 4597, 4599, 4600.

"Journal of Agricultural Research," Vol. 63, Nos. 9-10.

"Agricultural Gazette of New South Wales," Vol. 52, Part 12.

"Indian Journal of Agricultural Science," Vol. XI, No. 6.

"Annals of Biochemistry and Experimental Medicine," Vol. 1, No. 3.

"Biochemical Journal," Vol. 35, No. 7.

"Biological Reviews," Vol. 16, No. 4.

"Journal of the Indian Botanical Society," Vol. 21, Nos. 1 and 2.

"Journal of the Indian Chemical Society," Vol. 18, No. 10.

"Chemical Products," Vol. 4, Nos. 11-12.

"Experiment Station Record," Vol. 85, No. 6.

"Indian Forester," Vol. 68, No. 2.

"Transactions of the Faraday Society," Vol. 37, Nos. 10 and 11.

"Indian Farming," Vol. 3, No. 1.

"Review of Applied Mycology," Vol. 20, Part 10.

"Indian Medical Gazette," Vol. 76, No. 11.

"Mysore University Journal," Vol. 2, Pt. 11.

"Nature," Vol. 148, Nos. 3753, 3754, 3756, 3758-60.

"Indian Journal of Physics," Vol. 15, Part 5.

"Journal of Research" (National Bureau of Standards), Vol. 27, No. 5.

"Canadian Journal of Research," Vol. 19, No. 10.

"Science," Vol. 94, Nos. 2448-49.

"Science and Culture," Vol. 7, Nos. 7-8.

"Spolia Zeylanica," Vol. 23, Part 1.

"Indian Trade Journal," Vol. 144, Nos. 1856-59.

"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 11, Pt. 4.

BOOKS

"Ramalinga Reddy Sastyabdapurti Commemoration Volume," Pt. I—Sciences. (Andhra University, Waltair), 1941. Pp. 234.

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Indian Academy of Sciences: (*Proceedings*)

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Indian Association for the Cultivation of Science: (*Proceedings*)

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SUPPLEMENT TO CURRENT SCIENCE

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NEW CONCEPTS OF THE SOLID STATE*

BY SIR C. V. RAMAN

MY first duty is to thank the authorities of the Nagpur University on behalf of the Indian Academy of Sciences for the invitation which has enabled the Annual Meeting of the Academy to be held this year under the auspices of the University. The Fellows of the Academy deeply appreciate the labours of the Chairman and members of the local Committee and of Prof. Moghe in making the arrangements for the meeting and are grateful for the hospitality which has been generously provided for the occasion.

* * * *

For good or for evil, we live in an age of science. No one who is familiar with the history of science would fail to recognize the great influence which has been exercised on its progress by the work of the various national academies of science, as for instance the Royal Society of London and the Academy of Sciences at Paris. The publications of these academies are the primary records of scientific discovery and invention in their respective countries. To no small extent, also, the Academies have been responsible for the promotion and encouragement of research work and for the co-ordination of the research activities of the Universities. During the seven years the Indian Academy of Sciences has been in existence, it has striven to fulfil these functions in our country. The *Proceedings* of the Academy which have appeared punctually, month after month, embody the best part of the research work done in most of the Indian Universities. It is greatly to be desired that these Universities appreciate what the Academy is doing for them and help the Academy to carry on under the present difficult conditions.

* * * *

I propose to devote my address this year to an exposition of the new ideas concerning the solid state of matter which have emerged from recent

* Presidential Address to the Indian Academy of Sciences at the Annual Meeting held at the Nagpur University on the 24th of December 1941.

investigations made at Bangalore. The vast majority of actual solids are crystalline in structure and are either single crystals or else consist of polycrystalline aggregates. The gateway to an understanding of the solid state is therefore to be found in the study of crystals. The most effective starting point for such a study is, again, the ultimate structure or atomic architecture of the solid. The physics of the solid state of matter indeed concerns itself largely with the relationship between the atomic grouping in space which characterizes a crystal and the physical behaviour of the solid in various circumstances.

As is well known, crystals often possess beautiful external forms with specific geometric features. The symmetry characters of these geometric forms stand in the closest relation to the physical properties of the solid, such relationship being most evident when we consider those properties which vary with direction. The study of the geometric forms and of the physical properties of crystals resulted in the classification of crystal forms into six or seven systems and their further sub-division into thirty-two classes of crystal symmetry. It is natural that crystallographers were led by such studies also to speculate on the features in the internal architecture of crystals to which could be ascribed the external symmetry properties manifested by them. The theoretical investigations which dealt with this problem resulted in the recognition that a crystal is essentially a repetitive pattern in space and that the material particles of the solid are arranged in regular geometric order in a three-dimensional space-lattice. The discovery of the 14 possible kinds of space-lattice and of the 230 possible ways of grouping the atoms, each in its own appropriate type of space-lattice and coming under one or another of the 32 possible symmetry classes, gave the necessary precision and completeness to such general notions of crystal architecture.

The ideas of the mathematical crystallographers of the nineteenth century found a spectacular confirmation in Laue's great discovery made in 1912 of the diffraction of X-rays by the space-lattice of crystals. During the thirty years which have elapsed since that discovery, a vast amount of detailed knowledge regarding the structure of individual crystals has been built up by the labours of the X-ray crystallographers. Around such knowledge, again, there has been a great deal of discussion regarding the nature of the forces which held together the atoms, ions or molecules in a crystal in the form of a coherent solid.

* * * *

It must be recognized that the concept of a regularly ordered assemblage of atoms, ions or molecules in a space-lattice is only a static description of crystal structure and does not suffice to give a complete view of

the solid state. That the density and many other physical properties of a solid vary with temperature is clear indication that the atomic positions in a crystal are subject to disturbance by thermal agitation. A description of the possible atomic movements in a crystal is thus as important for crystal physics as a knowledge of the static structure. In other words, a dynamic picture of the crystalline state is required as a complement to the static picture furnished by the space-group theory. The possible modes of atomic vibration would evidently be determined by the atomic groupings in the crystal lattice and the forces that come into play when such grouping is disturbed. It follows that the static and dynamic aspects of crystal architecture should stand in the closest relationship to each other.

A dynamic concept of the solid state is necessarily the starting point in any consideration of the thermal properties of a crystal, *e.g.*, its specific heat, thermal expansion or thermal conductivity. It is equally fundamental in any attempt to elucidate such physical properties of solids as are notably influenced by temperature, *e.g.*, the electrical resistivity of metals. The subject of crystal dynamics assumes a special importance in considering the effects arising from the propagation of electromagnetic waves through crystals, *e.g.*, the scattering of light or the diffraction of X-rays. Spectroscopic and X-ray studies on crystals indeed afford us a penetrating insight into the problems of the solid state.

* * * *

The theorists who have handled such problems in the past have proceeded by carrying over notions derived from the classical theory of vibrating elastic solids into the domain of atomic dynamics. The history of physics during the present century suggests that all such extrapolations from macroscopic to atomic concepts must be regarded with caution. The extrapolations made in the Debye and Born theories of crystal dynamics do not, however, appear to be justified even from a purely classical point of view. It is not surprising, therefore, that the conclusions derived from these theories fail to survive the test of comparison with the experimental facts in several different branches of research. Before we proceed to consider evidence of this kind, it appears desirable to examine the foundations on which these theories rest.

* * * *

We may, in the first instance, comment on the well-known specific heat theory of Debye which has had the run of the text-books of physics for many years and even yet seems to be in favour. The theory assumes that the thermal energy of a solid may be identified with the energy of elastic waves travelling within it, and gives an expression for the energy in terms

of the velocities of these waves. That these assumptions are unjustifiable is evident from Debye's own formulæ. For, the calculation shows that a very large proportion of the elastic vibrations must be assumed to possess wave-lengths comparable with the lattice spacings of the crystal. Their frequencies also become comparable with those of the vibrations of the individual atoms. Even according to the classical principles, vibrations of such short wave-lengths and high frequencies could scarcely be expected to travel through the crystal with the assumed acoustic velocities. Indeed, the familiar fact that thermal energy does not travel at all but only diffuses with extreme slowness in solids is a clear disproof of the basic assumptions of the Debye theory. Far from supporting the postulates of the theory, the facts point to exactly the opposite conclusion, namely that no sensible part of the thermal energy of solids consists of the elastic vibrations of macroscopic physics.

The so-called postulate of the "cyclic lattice" on which the crystal dynamics of Born is based was introduced by him as a mathematical device to escape the difficulties which he believed to arise from the unspecified conditions at the external boundary of the crystal. The postulate in effect prescribes "wave-lengths" for the atomic vibrations in the crystal which bear no relation to its internal architecture but are related to its external dimensions in exactly the same way as the elastic vibrations of macroscopic physics. The postulate of the cyclic lattice has no theoretical justification and its introduction makes Born's approach to the problem of crystal dynamics wholly unreal and no less open to criticism than the theory of Debye.

The fallacy of the basic ideas underlying the Debye and Born theories becomes evident when we consider the nature of the vibrations within a solid indicated by the classical theory of elasticity. The form and size of the external boundary of the solid determines the possible modes of elastic vibration. In each individual vibration, the motion at all points within the solid has a specifiable frequency and a coherent phase-relationship. But there would be an immense number of such modes with varying frequencies. The superposition of all such modes, assumed to be co-existent, would therefore result in the agitation within the solid being of a completely chaotic character, varying from point to point and from instant to instant without any recognizable periodicity in space or recurrence in time. Thus, in effect, the assumptions made in the Debye and Born theories are equivalent to the assertion that while the static arrangement of the atoms in a crystal is one of perfect order and regularity, the dynamic character of their movements is one of perfect chaos and disorder, indeed exactly of the same kind as the movements or vibrations of the molecules of a gas. This

conclusion is obviously so improbable that we may well feel justified in rejecting without hesitation the premises on which it is based.

* * * *

A crystal, as we have seen, is a periodic array of similar particles, similarly situated and capable of influencing each other's movements. It follows that the vibrations of such an assemblage should exhibit a high degree of orderliness, approaching the ideal of a perfectly co-ordinated vibration in which the frequency, amplitude and phase are identically the same throughout the crystal. To picture such a vibration, we may first consider the group of the atoms present in an individual cell of the space-lattice. The internal vibrations of such a group would comprise several distinct modes determined by the number of atoms present. Each such vibration may then be pictured as occurring in identically the same way in every cell of the crystal lattice. Geometrically, such an oscillation could be represented as a periodic movement, relative to each other, of the inter-penetrating simple lattices of similarly placed atoms of which any crystal may be regarded as built up. Such a vibration would have a uniquely definable frequency, and the vibration spectrum of the crystal would therefore consist of a finite number of discrete monochromatic frequencies.

Thus, instead of an infinite array of choatic movements varying arbitrarily in phase from cell to cell of the crystal, and having a continuous spectrum of frequencies, we obtain a finite group of vibration modes with space-patterns coinciding with the lattice structure of the crystal and having a set of discrete monochromatic frequencies. These vibrations are essentially periodic changes in the fine structure of the crystal and do not involve mass movements of the substance of the solid. Hence, neither the existence of an external boundary nor the conditions restraining its movements can have any influence on such vibrations.

The most appropriate choice for the space unit of the three-dimensional repetition-pattern of the atomic vibrations is evidently that which enables all the modes possible to be included without redundancy. Hence the appropriate choice is not the cell having the smallest dimensions or including the least number of atoms, but one which is fully representative of the crystal structure and symmetry. In the majority of crystals, the number of atoms included in such a space-unit would be fairly large. Hence, the internal vibrations of the group of atoms contained in it would comprise the largest proportion of the available degrees of freedom of movement, indeed all except a small residue representing the translatory movements of the chosen cell. To enable these latter to be included in the scheme, we may consider the internal vibrations of a group of atoms contained in the cells of a super-lattice having cells of twice the linear dimensions and

therefore of eight-fold volume. Proceeding in this way by successive steps, the vibration spectrum of the crystal could be developed with all desirable completeness as a set of monochromatic frequencies.

* * * *

It will be realised that the geometric characters as well as the frequency distribution of the atomic movements in crystals obtained in this way would be radically different from those indicated by the Debye and Born theories. It is evident also that the new concepts involve striking differences in the spectroscopic, X-ray and thermal behaviour of crystals as compared with those derived from the older ideas. The issues arising between the new and the older concepts are thus capable of being brought to an exact experimental test.

* * * *

The atomic vibrations in crystal lattices are accessible to optical and spectroscopic investigation in several different ways. A method which makes the entire frequency range conveniently accessible to observation is the spectroscopic study of the scattered radiations emerging from a crystal traversed by monochromatic light. The most striking feature revealed by such studies with crystals is the extreme sharpness of the displaced lines appearing in their spectra. Even in those cases where the lines are somewhat diffuse, they sharpen into the finest lines when the crystal is cooled down to low temperatures. The monochromatism of the lattice frequencies thus indicated is especially significant when the vibrations are observable only in the crystalline state, in other words when the lines disappear in the molten or dissolved material. These facts are wholly inconsistent with the Debye and Born theories. Indeed, it may be said that the character of the spectra observed even with the simplest of crystals bears no resemblance to the diffuse continua suggested by these theories. Evidence confirmatory of the new concepts of crystal dynamics is also furnished by the absorption and luminescence spectra of crystals observed at low temperatures, *e.g.*, diamond. Here again, the lattice spectrum is revealed as a set of discrete monochromatic frequencies stretching down to low values, in startling contrast with the conclusions of the Debye and the Born theories.

* * * *

As already explained, the new concepts indicate a close correspondence between the static structure and the dynamic behaviour of a crystal, in other words that the atomic vibration patterns are either identical with or closely related to the lattice structure of the crystal. As an immediate consequence of this relationship, it follows that the lattice planes of a

crystal should give two distinct types of X-ray reflection—a dynamic reflection with altered frequency in addition to the static reflection of unmodified frequency discovered by Laue. The more perfectly co-ordinated is the oscillation of the lattice structure, the more perfect would be the geometric character of the dynamic X-ray reflections. Hence, these reflections should be shown in the most striking way by diamond-like structures in which the entire crystal is practically a single molecule and less perfectly by other crystals in which the lattice structure is of a more open kind.

That the lattice planes in crystals do give the new type of dynamic X-ray reflection here indicated and that such reflections are incapable of being explained on the older theories was discovered and announced by myself and Dr. Nilakantan in March 1940. In a symposium of fifteen papers published in the *Proceedings* of the Academy for October 1941, the theory of these new X-ray reflections, their relation to quantum mechanics and the experimental facts as observed with diamond and numerous other crystals have been thoroughly explored. It has been proved that the experimental facts are, on one hand, fatal to the Debye and Born theories and that on the other hand, they give the strongest support to the new concepts of the solid state.

* * * *

To the pioneer investigations of Einstein, we owe the basic principles of the quantum theory of the specific heat of solids. He showed clearly that the thermal energy of a crystal stands in the closest relation to its optical properties and could, in fact, be expressed in terms of the characteristic frequencies of atomic vibration appearing in the infra-red region of frequency. In his earliest paper, Einstein suggested that the atomic frequencies could be assumed to be monochromatic. Considering one such characteristic frequency in the case of diamond, he evaluated the same from the specific heat data. It will be seen from our present discussion that the basic assumption of monochromatism was justified, and that the only amendment needed in Einstein's theory was the inclusion of the full number of discrete monochromatic frequencies demanded by the lattice structure of the crystal with the appropriate statistical weights. It is also seen that the application of the macroscopic theory of elastic vibrations due to Debye, successful though it seemed at the time, was, in reality, a false step.

In a symposium of seven papers published in the *Proceedings* of the Academy for November 1941, the problem of the thermal energy of crystalline solids has been discussed fully from the new point of view and compared with the experimental data for a variety of substances. In several cases where the necessary spectroscopic data were available, these

have been effectively made use of. In other cases, *e.g.*, metals, the specific data themselves have been utilised to evaluate the atomic frequencies. The most significant fact which emerges from the symposium is that the experimental facts in several cases which refused obstinately to fit into the Debye and Born theories find a natural explanation in the new concepts without the aid of any special hypothesis.

* * * *

Summary

The postulates on which the Debye theory of the specific heat of solids and the Born crystal dynamics are respectively based have been critically examined and shown to be theoretically untenable. Since a crystal is a three-dimensionally periodic grouping of similar oscillators coupled together, it follows that the modes of vibrations possible would be also space-periodic, the geometric modes being determined by the characters of the atomic space-grouping in the crystal. They would further form a finite and enumerable set of monochromatic frequencies. The spectroscopic, X-ray and thermal behaviours of a crystal would on these views be radically different from those consequent on the Debye and Born theories. The experimental facts are found to contradict the conclusions of these theories and on the other hand, to be in full accord with the new concepts.

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CURRENT SCIENCE

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SIR WILLIAM HENRY BRAGG, O.M., F.R.S.

BRITISH Science loses one of its most distinguished leaders in the death of Sir W. H. Bragg "full of years and of honours" on the 12th of March 1942. Born in Great Britain and educated in the Isle of Man and at the Cambridge University, he went to Australia as Professor at the University of Adelaide in 1885 and by his work there won his election to the Fellowship of the Royal Society in 1906. He returned to Great Britain in 1909 as Professor at the Leeds University, moving to the University College, London as Quain Professor in 1915. He resigned this chair in 1923 to take up the Directorship at the Royal Institution, a position which he continued to hold till his death at the age of nearly 80 years.

There are many interesting references to Sir William Bragg and extracts from the correspondence which passed between him and Lord Rutherford in Eve's biography of the latter. These throw a vivid light on the scientific interests of both men and their influence on each other. The earliest reference dates to the year 1895 when Rutherford visited Bragg at Adelaide while on his way from New Zealand to Cambridge to join as a research student under J. J. Thomson! Thus, in a sentence, are linked the names of a trio who symbolised British physics in the first three decades of the twentieth century, just as the trio Kelvin, Stokes and Rayleigh symbolised it in the last three decades of the nineteenth century. One has only to recall the names of these men and their achievements to realise the tremendously rapid development of physics during this epoch and to appreciate their share in creating the objective or experimental basis on which the structure of physics rests at the present time.

The enormous interest excited by the discovery of radio-activity and by the early

investigations of the Curies and of Rutherford appears to have been responsible for galvanising the Adelaide Professor into a career of research activity. Indeed, till 1912, the scientific interests of Bragg appear to have centred largely on radioactivity and the ionising radiations produced by it. The earliest published paper by Bragg to which I have been able to find a reference appeared in the *Philosophical Magazine* for December 1904 and deals with this subject. Both success and recognition came to him very quickly. His principal discovery was the recognition that alpha particles from radium and its subsequent products had definite but different ranges in air. A little later, he also made the discovery that when gamma rays from radium struck a thin plate of metal, the radiation forwards were greater than the back radiations. This surprising observation led him to put forward the view that both gamma rays and X-rays were corpuscular in nature. In fact, Bragg became a strong advocate of the idea that X-rays were neutral doublets made up of both kinds of electricity. This opinion was contested by J. J. Thomson and by C. G. Barkla who put forward evidence supporting the view that X-rays were in the nature of electrical waves.

The epoch-making discovery of the diffraction of X-rays in crystals made in 1912 by Laue had the effect, not only of convincing Bragg of the error of his views regarding the nature of X-rays, but also of setting his feet on the path of research which earned for him the award of the Nobel Prize for Physics in 1915 jointly with his son W. L. Bragg. In the special number of *Current Science* entitled "Laue Diagrams" published in 1937, the story of Laue's great discovery and of its subsequent developments has been told in full by the leading authorities on the subject. It is therefore unnecessary here to recapitulate this well-known chapter of modern scientific history. The recognition of the importance of the work of the Braggs in this field was to no small extent aided by the publication of their joint work entitled "X-rays and Crystal Structure" which appeared in 1915 and went through several editions. A smaller book entitled "An Introduction to Crystal Analysis" by W. H. Bragg published in 1928 was also a useful treatise of a more popular kind.

The high position that Sir William Bragg occupied both in the esteem of scientific men and in the public eye was, I believe, to no small extent based on an appreciation of his remarkable gifts for popular exposition of scientific topics, derived no doubt from his long experience as a teacher. The Royal Institution offered him a splendid forum for the exercise of these gifts. The subsequent publication of these lectures in a series of charmingly produced and illustrated volumes made them accessible to a world-wide audience. "The World of Sound", "Concerning the Nature of Things", "Old Trades and New Knowledge" and "The Universe of Light", are a series of books which will continue to delight both young and old for many years.

My first personal contact with Sir William Bragg was in the summer of 1921 when I visited him at his laboratory at the University College in London. He showed me a model of the naphthalene crystal on which he was then at work and which he made the subject of his Presidential Address to the Physical Society later in the same year. I next saw him when I was in London in the summer of 1924 prior

to the visit of the British Association to Canada in that year. Bragg was then at the Royal Institution, still greatly interested in his organic crystals. He had Muller, Shearer and others with him hard at work preparing the long-chain aliphatic compounds and studying their structure. Bragg seemed to be much happier in the atmosphere of the Royal Institution than at the University College. Possibly he had had enough of University teaching and examinations after doing them for nearly forty years! Bragg presided at my lecture on the Scattering of Light to the British Association at Toronto. We were in the same train together travelling across Canada to Victoria and back. My contacts with Bragg on my subsequent visits to London in 1929 and 1930 were very brief.

Sir William's laboratory at the Royal Institution has been for many years a place of pilgrimage to X-ray workers from all the world over. My own personal impression derived from such contacts as I had was that Sir William was a very unselfish and loveable personality, anxious to help others forward in their work. He had, of course, his limitations, one of which was, I think, an insufficient appreciation of the newer viewpoints in theoretical physics. But this was not surprising, seeing that he belonged quite as much to the nineteenth century as to the twentieth.

Like "J. J." and Rutherford, he lived to achieve the highest honours which a British man of science could hope to achieve in his own country, namely the Copley Medal, the Presidentship of the Royal Society and the Order of Merit. Curiously enough, his Knighthood was, I believe, given not for his work on X-rays, but for his studies on sound-ranging in the last war!

C. V. RAMAN.

THE NUTRITION SOCIETY

A NEW scientific society, the Nutrition Society, has been inaugurated in England by Professor F. G. Hopkins, with Cambridge as its Headquarters. Sir John Orr, who is one of the few to realize the importance of Nutrition in relation of national efficiency, is the first Chairman of the Society.

Work on Nutrition is, in fact, being carried on from different angles by medical practitioners, biochemists and physiologists, agriculturists and veterinarians, dietitians and sociologists, economists, statistitians, food technologists and administrators. The new Society will provide a common meeting-ground for the discussion of all aspects of Nutrition, formerly partitioned by barriers of specialisation.

In this country, problems of nutrition are being studied principally at Coonoor under the direction of Dr. W. R. Aykroyd. There are also a few centres of research, where work of a basic character is being done. Several of the Provincial and State Governments have carried out dietary and economic surveys in their respective provinces. For now more than a decade, Rao Bahadur B. Viswanath, since his discovery that farm-yard manure raises crops with richer content of vitamins, has been advocating a closer collaboration between the science of agriculture and the science of nutrition. The Indian Research Fund Association and the Lady Tata Trust, among others, have encouraged research in the field of Nutrition in this country, by financing schemes of research in this subject.

So far as we are aware there does not appear to be any Central Organisation, which could correlate and organise these research activities and utilise the results in building up a healthy and virile nation. Does not the present afford an opportune moment to organise a society on lines similar to those adopted by the Nutrition Society of England?

EMIL FISCHER'S WORK ON THE CHEMISTRY OF HEXOSES

BY

BAWA KARTAR SINGH

(University of Allahabad)

THIS is a very brief note on Emil Fischer's work on the hexoses; it is just 50 years ago that Emil Fischer published his first paper on the structure of hexoses.

Upto the year 1880, our knowledge of the sugar group was very meagre and consisted of a chaos of isolated facts. Zincke (1876) assigned the ketonic structure to glucose (CH_2OH-CHOH-CHOH-CHOH-CO-CH_2OH) and fructose (CH_2OH-CHOH-CHOH-CO-CHOH-CH_2OH), but Kiliani (1886) corrected this view by the application of cyanohydrin reaction and represented these compounds thus: Glucose—C^6H_2OH-C^5HOH-C^4HOH-C^3HOH-C^2HOH-C^1HO, Fructose—CH_2OH-CHOH-CHOH-CHOH-CO-CH_2OH. Kiliani was also responsible for showing arabinose to be a pentose (1886) and galactose (1885) to be a straight chain pentahydroxyaldehyde, isomeric with glucose. But Kiliani's success was short lived: he could not follow it up in view of the almost insurmountable experimental difficulties; sugars crystallise with difficulty even when pure; when other substances are present, the task of isolating a sugar from the mixture is hopeless. Such was in brief the state of sugar chemistry when Emil Fischer started his researches on hexoses in 1887, and brought them to a successful conclusion within less than a decade. There were three factors which contributed to the remarkable achievements of Fischer in this extremely difficult field of work. Firstly he possessed in himself rare skill, patience and insight which are seldom combined in one individual. The second factor which ensured his success was the doctrine of the asymmetric carbon atom propounded by Van't Hoff and Le Bel in 1874. Fischer made it the theoretical basis and the guiding principle in these astonishingly successful researches which in turn vindicated the truth of the new doctrine of molecular configuration. The third factor which assisted this experimental skill and theoretical insight was his discovery of phenylhydrazine in 1875. This substance acted as a magician's wand in Fischer's hands. Fischer found that hexoses first react with one molecule of phenylhydrazine to give a phenylhydrazone which is usually soluble and escapes detection, but with an excess of the base (2 molecules), the hydrozone is converted into an osazone: C^6H_2OH-C^5HOH-C^4HOH-C^3HOH-C^2-$C^1H = N$-NHC_6H_5.

$$\begin{array}{l} \quad\quad\quad\quad \| \\ C_6H_5\text{-}HN\text{-}N \end{array}$$

The osazones, being insoluble in water and easily crystallisable from organic solvents, were thus found by Fischer to be very suitable for detecting and identifying sugars by their melting points. Fischer (1887) further found that several sugars give identical osazones, namely, glucose, mannose, and fructose give one and the same derivative (glucosazone). The osazones on hydrolysis and subsequent reduction yield ketoses. The Kiliani structural formula of glucose contains 4 asymmetric carbon atoms, numbered 2, 3, 4 and 5 and this formula according to Van't Hoff and Le Bel theory, should exist in 16 optically active forms in 8 opposite pairs. Sugars producing the same osazone thus had identical structure on all but the first two carbon atoms, numbered 1 and 2.

Another even more important application of osazones was in the complete synthesis of glucose, fructose and mannose in their enantiomorphous forms. Starting from α-acrose (*dl.* fructose) which he had obtained separately from formaldehyde, acrolein dibromide and glycerose, Fischer was able to achieve the synthesis of the above-mentioned sugars by a series of difficult operations, which consisted in resolving the sugars and the corresponding acids into their enantiomorphous forms by Pasteur's methods, reducing the sugar acids (lactones) into the corresponding sugars in acid solution, transforming a sugar acid into

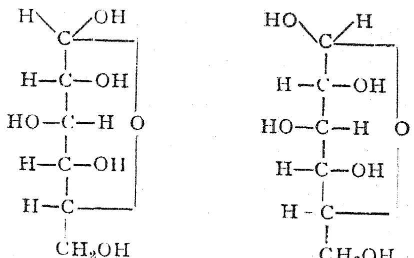
an isomeric one by heating it at 140° C. with pyridine or quinoline by means of an epimeric change, in which the configuration of the carbon atom adjacent to the carboxyl group becomes inverted. This enabled Fischer (1889 and 1890) to produce *l*-glucose, *d*-talose, and *d*-idose through *l*-mannonic, *d*-galactonic, and *d*-gulonic acids respectively.

No less than 16 isomeric aldohexoses are possible which possess the structural formula of a straight chain pentahydroxyaldehyde, CH_2OH-CHOH-CHOH-CHOH-CHOH-CHO. The principles which Fischer employed in elucidating the space configurations of the hexoses were dependent on the identity of the osazones of the different sugars, the oxidation of sugars to *meso* acids or reduction to *meso* alcohols, methods for building up or degrading sugars and transformations of sugar acids into their isomers by epimeric changes. Thus the projection formulæ of glucose, mannose and fructose obtained in this way are given below by way of illustration:

1 ..	CHO	CHO	CH_2OH
2 ..	H—C—OH	HO—C—H	CO
3 ..	HO—C—H	HO—C—H	HO—C—H
4 ..	H—C—OH	H—C—OH	H—C—OH
5 ...	H—C—OH	H—C—OH	H—C—OH
6 ..	CH OH	CH_2OH	CH_2OH
	d-glucose	*d*-mannose	*d*-fructose

By the application of these methods and reasonings, Fischer synthesised and configurated twelve out of the sixteen theoretically possible aldohexoses, and since then the remaining two pairs (allose and altrose) have been configurated by Levene and Jacobs (1910).

This account of the chemistry of hexoses, illustrating as it does a remarkable combination of theory and practice, will be incomplete without reference to another advance which has proved highly fruitful in the whole domain of carbohydrates. In the foregoing account the aldehyde structure of the sugars has been assumed. That sugars and their derivatives possess oxide ring structures was established by unequivocal evidence. From an assumed analogy with γ-lactones, Fischer assigned the butylene or 1 : 4 oxide ring to α- and β-methylglucosides and the parent sugars, but this structure was subsequently corrected by the work of Haworth (1925) which gives the pyranose formulation:



α-glucose, $[\alpha]_D$ 110° → 52·5° β-glucose, $[\alpha]_D$ 17·5° → 52·5°

His discovery of γ-methyl-glucoside in 1914 led to the recognition of a different cyclic structure from that given in the foregoing formulation and laid the foundation of work associated with Purdie and the St. Andrews School. Just as phenylhydrazine had proved a valuable weapon in the hands of Fischer, this new development was made possible by the discovery of another weapon in the 'methylation process', and led to the recognition of five different oxide rings for *d*-glucose, giving ten isomerides of *d*-glucose, excluding the aldehyde form.

The evolution of a single straight chain pentahydroxyaldehyde formula into 16 optically active configurations and their subsequent possible expansion into 160 isomeric formulæ, having five different oxide ring structures, furnishes a most remarkable development of molecular structure and molecular configuration, based on the theoretical speculations of Kekule, Van't Hoff and Le Bel.

There is thus no doubt that this later development by Fischer will continue to inspire the prosecution of research in this field by several generations of chemists.

ON LATIN AND HYPER-GRAECO-LATIN CUBES AND HYPER-CUBES

BY

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LATIN and Hyper-Graeco-Latin squares were first introduced by Euler[1] in 1782 and have since been extensively studied by a number of mathematicians like Gunther,[2] Cayley,[3] Maillet,[4] Coccoz,[5] Akar,[6] Brocard,[7] Tarry,[8,9,10] Macmahon,[11] MacNeish,[12] Margossian,[13,14] Fisher and Yates,[15,16] Fisher,[17] Bose,[18] Stevens[19] and Norton.[20] To Fisher is due the credit of pointing out their uses in the design of experiments; and with the realisation of their fundamental importance in the theory of this branch of statistics, much attention has been devoted to their study by statisticians in recent years.

2. Fisher introduced the idea of confounding of interactions in symmetrical factorial arrangements, which was extended by Yates to agronomic tests, involving a number of varieties equal to a prime positive integer or a power of prime, in order to increase the 'efficiency' (or accuracy) of the experiments. But it is no disparagement of their work to say that there is a lack of a unified general solution. Nair's work,[21,22] done subsequent to this, was an advance over our then existing knowledge of factorial arrangements in that he developed a method of constructing confounded arrangements in an s^m design, (s a prime positive integer or a power of a prime) in s^2-plot blocks, based on his theory of interchanges derivable from the associated Hyper-Graeco-Latin squares.

But a more complete solution in the case of the general symmetrical factorial arrangement was given by Bose and Kishen,[23] whose investigations achieved the unification and systematization which were lacking in previous work on the subject. Besides succeeding in giving a general method for the formation of confounded arrangements in an s^m design in blocks of s^{m-k} plots and the identification of the confounded degrees of freedom, the authors were able to enunciate the important principle of generalized interaction which enables the best sets of treatment comparisons which may profitably be confounded in any given case to be set down easily and elegantly. It is hoped that the concept of Latin and completely orthogonalized Hyper-Graeco-Latin cubes and hyper-cubes which is now being introduced may be helpful for a fuller understanding of the theory of the general symmetrical factorial arrangement.

3. A Latin cube of the *first order* of side s may be defined as a cube arrangement of s^3 letters, s^2 of each of s kinds, such that each letter occurs exactly s times in each of its three sets of s planes, parallel to the three co-ordinate planes OX_1X_2, OX_1X_3 and OX_2X_3. A Latin cube of the *second order* of side s may be defined as a cube arrangement of s^3 letters, s of each of s^2 kinds, such that each letter occurs exactly once in each of its three sets of s planes parallel to the co-ordinate planes. Thus for $s = 3$, Latin cubes of the first and second orders may be diagrammatically represented as under in Figs. 1 and 2 respectively.

4. If an s-sided Latin cube of the *first order* is superimposed on another s-sided Latin cube of the *first order* such that every letter of one cube occurs exactly s times with every letter of the other cube, the two Latin cubes may be said to be orthogonal to each other. When the letters of the first

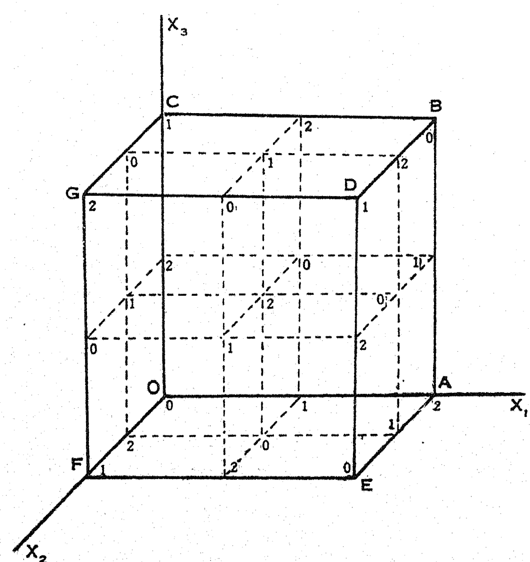

FIG. 1

2×2×2. Latin Cube of First Order

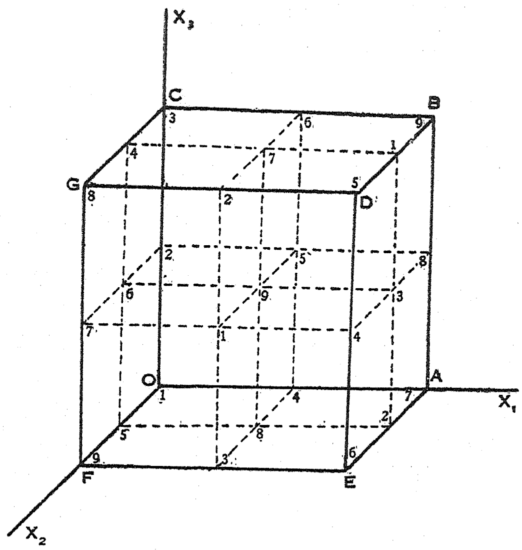

FIG. 2

$2 \times 2 \times 2$. Latin Cube of Second Order

cube are denoted by Latin letters and those of the second cube by Greek letters, and the second is superimposed on the first, the two together may be said to constitute a Graeco-Latin cube of the *first order*. The number of Latin cubes of the first order constituting a completely orthogonalized Hyper-Graeco-Latin cube of the first order has been found to be $s^2 + s - 2$.

5. In general, we may define an s-sided m-fold Latin hyper-cube of the *r-th order* as an m-fold hyper-cube arrangement of s^m letters, s^{m-r} of each of s^r kinds, such that each letter occurs exactly s^{m-r-1} times in each of its m sets of s $(m-1)$-flats, parallel to the m co-ordinate $(m-1)$-flats $OX_1X_2 \cdots X_{m-1}$, $OX_1X_2 \cdots X_{m-2}X_m, \cdots$ $OX_1X_2 \cdots X_{i-1}X_{i+1} \cdots X_m, \cdots OX_2X_3 \cdots X_m$. Two such Latin hyper-cubes, one superimposed on the other, such that every letter of the one occurs exactly s^{m-2r} times with every letter of the other, may be said to be orthogonal to each other. Denoting, as before, letters of the first hyper-cube by Latin letters and those of the second hyper-cube by Greek letters, the composite hyper-cube may be said to constitute an m-fold Graeco-Latin hyper-cube of the *r-th order* and it is obvious that the highest possible value for r is $\frac{m-1}{2}$, when m is odd, and is $\frac{m}{2}$, when m is even.

6. I have been able to establish that Latin cubes and hyper-cubes of the first order of any side exist and that s-sided m-fold Latin hyper-cubes of the rth order $[r \leqq (m-1)$, the sign of equality not holding in certain cases$]$ also exist, s being a prime positive integer or a power of a prime. I have also been able to demonstrate that the existence of an s-sided m-fold Hyper-Graeco-Latin hyper-cube of the *first order* is exactly equivalent to the existence of the finite hyper-dimensional projective geometry $PG(m, s)$, whence it follows that the total number of m-fold Latin hyper-cubes of the *first order* constituting an s-sided m-fold completely orthogonalized Hyper-Graeco-Latin-hyper-cube of the *first order* is $s^{m-1} + s^{m-2} + \cdots + s^2 + s - (m-1)$. For full details the interested reader is referred to the author's paper on the subject to be published shortly elsewhere.

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LETTERS TO THE EDITOR

CRYSTAL ORIENTATION AND THE RAMAN SPECTRUM OF CALCITE

NEDUNGADI[1] and Bhagavantam[2] studied the effect of crystal orientation on the Raman spectra of sodium nitrate and calcite respectively. It has been observed in both the cases that the low frequency lines are very weak while the line due to the total symmetric oscillation comes out quite strongly when the incident light vector lies in the plane of the nitrate or the carbonate ion and the scattered light is along the optic axis. The reverse is the case when the incident light vector is parallel to the optic axis and the direction of the scattered light lies in the plane of the nitrate or carbonate ion. The above observation clearly indicates that the various tensor components, especially in the case of the total symmetric oscillation, are unequal among themselves as $a_{xx} = a_{yy} \neq a_{zz}$. Bhagavantam has postulated that in the case of the 1085 line in calcite, a_{xx} and a_{yy} are each about three times as large as a_{zz}. Intensities involving a_{xx} or a_{yy} will correspondingly be about ten times as large as those containing a_{zz}.

The author has obtained the Raman spectra of a well polished one-inch cube of calcite, cut in such a manner that its optic axis is parallel to one of the edges, for both the above-mentioned orientations on the same photographic plate. Great care has been taken to see that the time of exposure and the intensity of the source remained the same while photographing the two spectra. A set of intensity marks obtained by the method of varying slit widths is recorded on the same plate and the relative intensities are obtained from the density-log intensity curves in the usual manner. The ratio of the intensities of the 1085 line, in the two cases, is obtained as 7·94 for the 4358 excitation and 7·38 for the 4047 excitation. Hence, it may be concluded that the corresponding tensor components are related as $a_{xx} = a_{yy} = 2 \cdot 8\, a_{zz}$.

The author desires to express his grateful thanks to Prof. S. Bhagavantam for his keen interest in this work.

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February 18, 1942.

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RAMAN SPECTRA OF IODIC ACID AT DIFFERENT DILUTIONS

FROM a study of the variation with concentration of physico-chemical properties, such as density, viscosity, surface tension parachor, refractive index, magnetic susceptibility, etc., M. R. Nayar and co-workers[1] have found breaks in the various curves at definite concentrations, namely, 0·09 N and 0·04 N. According to them a concentrated solution contains mainly trimeric molecules $(HIO_3)_3$, which gradually change into dimers $(HIO_3)_2$ and then into monomers and simple ions as dilution increases. The course of depolymerisation of the trimeric molecules of the acid has been pictured as:

$$\tfrac{1}{3}(HIO_3)_3 \xrightarrow[0\cdot09\ N]{} \tfrac{1}{2}(HIO_3)_2 \xrightarrow[0\cdot04\ N]{} HIO_3 \rightarrow H^+ + IO_3^-$$

The breaks in the curves are attributed to transitions from one kind of molecule to another.

The fact that a solution of iodic acid yields different Raman spectra at different concentrations was first pointed out by Nayar and Sharma,[2] and subsequently confirmed by Venkateswaran.[3] In the present investigation Raman spectra of the acid solution have been obtained for concentrations ranging on either side of the transition points. Microphotometric records of all the plates were also obtained and the frequencies (wave numbers) were recorded (see table above).

The first five results refer to iodic acid, while the last one refers to potassium iodate. It is evident that the Raman spectra of the acid solutions are not changed very much down to a concentration of about 0·2 N. The most intense line 789 in band III, however, disappears at this dilution, while the line 804 previously of medium intensity now becomes the most prominent. The less prominent lines constituting bands I and II have all disappeared.

In 0·07 N solution a line 812 makes its appearance for the first time, which persists with further dilution, while all other lines disappear. This line which is the only one present in 0·03 N solution is given also by KIO_3 solution (0·2 N). This frequency may reasonably be attributed to free IO_3 ions, while the rest must be partly ascribed to polymers of the acid, and partly to modification of the IO_3 frequency due to co-ordination.

Concn.	Band I			Band II			Band III		
4·5 N ..	317(7)*,	332(7),	354(6),	449(1),	642(4),	653(3),	789(10)	806(8)	826(6)
1·0 N ..	318(4)	..	..	..	641(3),	654(2),	785(10)	807(9)	824(7)
0·2 N ..	..	..	..	..	..	..	..	804(5)	824(3)
0·07 N ..	..	..	..	..	..	..	..	804(5) 812(4)	828(2)
0·03 N ..	..	..	..	..	..	..	..	811	..
0·2 N (KIO_3)	..	..	..	..	..	..	..	811	..

* The numbers within brackets refer to intensity estimated visually.

The results in any case are in conformity with the physico-chemical observations already referred to. The detailed paper will be published elsewhere.

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February 20, 1942.

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PHOTOCHEMICAL ANALYSIS

SEVERAL methods[1] have been proposed for the estimation of mercuric chloride, but they are not satisfactory either on account of (1) cumbursomeness, involving considerable time, etc., or (2) lack of sufficient accuracy or (3) the use of costly reagents. In our method we made use of the photochemical reaction between mercuric chloride and potassium oxalate in aqueous solution. At laboratory temperatures, in the dark, there is no appreciable reaction, but on exposure to light of suitable wave-length there is copious precipitation of mercurous chloride. Working with Monax or Pyrex glass conical flasks in sunlight, we found that the reaction goes to quantitative completion in about 30 to 60 minutes, in the presence of a minute concentration of uranyl nitrate, which acts as the photosensitizer. After exposure to light for the requisite time, the mixture is treated without filtration with a known excess of standard solution of iodine in potassium iodide. The precipitated mercurous chloride dissolves readily according to the following reaction

$$Hg_2Cl_2 + 6\ KI + I_2 \rightarrow 2\ K_2\ Hg\ I_4 + 2\ KCl.$$

After adding the iodine solution, the flask is stoppered and allowed to stand for a few minutes with occasional agitation, until complete solution takes place. The residual iodine is titrated with standard sodium thiosulphate solution with starch as the indicator. From the volume of the standard iodine solution consumed in the oxidation of the mercurous to mercuric ion, we can calculate the amount of mercurous chloride formed in the photochemical reaction, and hence that of the mercuric chloride originally taken.

In the absence of the uranyl nitrate, the reaction takes place only very slowly. The uranyl nitrate does not interfere with the reaction or with the iodometric estimation in any manner, under the conditions described. The following table embodies typical results.

X ml. of M/20 $HgCl_2$ + X ml. of M/5 sodium oxalate + $\frac{X}{5}$ ml. of M/50 uranyl nitrate solution, exposed to bright sunlight for 45 minutes.

Volume of $HgCl_2$ solution (x)	Milligrams of Hg taken	Milligrams of Hg found	Error per cent.
15 ml.	150·45	150·14	0·2
10 ml.	100·30	100·00	0·3
5 ml.	50·15	50·03	0·24
2 ml.	20·06	19·95	0·55
1 ml.	10·03	9·09	0·40

If the exposure to light is unduly prolonged, the mercurous chloride formed tends to decompose further into mercury. The appearance of a slight incipient grey colour is an indication that the reaction is complete. While working with concentrations of mercury chloride lower than M/100, the concentration of oxalate should be reduced, as otherwise the mercurous chloride undergoes further decomposition to metallic mercury. The uranyl nitrate concentration is however, retained at the usual value. Working with M/200 solution of mercuric chloride, we used M/50 solution of sodium oxalate with good results. We found that even one milligram of mercury in the form of mercuric chloride can be estimated with ease and considerable accuracy.

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December 18, 1941.

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CATALYSIS OF DICHROMATE-HYDRIODIC ACID REACTION BY THE OXALATE ION

THE use of potassium dichromate as a primary standard in iodimetry is based on the following reaction.

$$Cr_2O_7^{--} + 14H^+ + 6I^- \rightarrow 3I_2 + 2\ Cr^{+++} + 7H_2O$$

The main features of this reaction are (1) increase in the speed of the reaction with increase in the concentration of iodide, dichromate and H^+ ion, and (2) the interference of the autoxidation of hydriodic acid by atmospheric oxygen, which becomes appreciable at high concentrations of acid and of iodide, and in the presence of light. In spite of suitable precautions taken to overcome the difficulties encountered, the titration of weak solutions of dichromate (0·01 to 0·001 N) gives uncertain results. I. M. Kolthoff[1] has endeavoured to find suitable positive catalysts for this reaction, in order to improve the method, but without success. During the course of some other work, we accidentally discovered that oxalate ion exerts a marked catalytic effect on the reaction between dichromate and hydriodic acid. As this result is of great analytical and theoretical significance, we investigated the phenomenon in some detail.

The following table embodies some typical results.

5 ml of 0·001 N $K_2Cr_2O_7$ solution + 1 ml of 2 N HCl + 1 ml of O·5 N KI + 2 ml of 1 per cent. starch + oxalate solution + distilled water, to make up to 20 ml.

Concentration of oxalate	Amount of iodine liberated in ml hypo solution instantaneously	Amount of iodine liberated in ml hypo solution in two minutes	Amount of iodine in ml hypo solution theoretical
Nil	3·77	4·56	5·40
0·000125 N	5·20	5·30	5·40
0·000250 N	5·30	5·36	5·40
0·000500 N	5·32	5·38	5·40
0·002500 N	5·37	5·38	5·40
0·010000 N	5·35	5·38	5·40

It will be seen from the above table that less than the theoretical quantity of iodine is liberated in the absence of oxalate, even when two minutes were allowed for the reaction. If an instantaneous titration is desired, Kolthoff recommends at least 20 ml of 4 N HCl per 100 ml of the reaction mixture. But it is the general concensus of opinion (*cf.* W. C. Vosburgh[2]) that at this high acid concentration the error due to air oxidation of hydriodic acid becomes appreciable.

From our results it is also evident that with a suitable concentration of oxalate, the quantitative liberation of iodine takes place almost instantaneously even at low hydrogen ion concentration, enabling the titration to be finished quickly. Control experiments have shown that, under our conditions, the reaction between oxalate and iodine and the reaction between oxalate and chromic acid do not interfere.

Oxalates of potassium, sodium and ammonium have been studied with almost identical results, so that we can conclude that it is the oxalate ion that exerts the catalytic effect. We also found that citrate and tartrate ions exert a positive catalytic influence, though to a lower degree than the oxalate ion. Succinate has no effect.

Fuller details will be published elsewhere.

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December 18, 1941.

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2-N¹-SULPHANILAMIDO-4-*n*-PROPYLTHIAZOLE

In a recent publication,[1] we have described the synthesis of a series of 5-alkyl derivatives of 2-sulphanilamidothiazole. As a sequel to this, we undertook to synthesise a series of 4-alkyl derivatives, of which only the methyl and ethyl[2] derivatives are known so far. 2-Sulphanilamido-4-*n*-propylthiazole has been synthesised as follows:

Butyrylchloride condensed with diazomethane in ethereal solution to yield the diazoketone (I) which on treatment with dry hydrogen chloride in ether solution yielded the corresponding chloroketone (II). On condensing the latter, with thiourea according to the usual procedure, 2-amino-4-*n*-propylthiazole (III) (picrate, m.p. 192° C.) was obtained. Treatment of this with acetsulphanilylchloride in pyridine solution furnished 2-acetsulphanilamido-4-*n*-propylthiazole (m.p. 202°) which on hydrolysis with

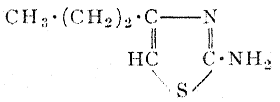
about 4 N hydrochloric acid yielded 2-sulphanilamido-4-*n*-propylthiazole (IV) (m.p. 143–44°).

$$CH_3\cdot(CH_2)_2\cdot CO\cdot CHN_2$$

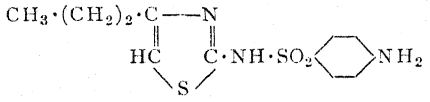
(I)

$$CH_3\cdot(CH_2)_2\cdot CO\cdot CH_2Cl$$

(II)



(III)



(IV)

This method is of general applicability to synthesise the homologous compounds but we have not so far prepared them because our stock of chemicals was too limited and, moreover, the results of testing the 5-alkyl derivatives of sulphathiazole in this Institute have indicated that the therapeutic activity is greatly diminished in the homologous series after the propyl derivative. Accidentally, however, we have discovered a much better method of preparing the 4-alkyl derivatives[3] which consists in preparing the 2-acetsulphanilamido-4-alkylthiazole derivatives with an additional carboxylic ester grouping in the side chain and then treating them with hydrochloric acid or alkali which not only hydrolyses the acetamino but also the ester grouping causing subsequent decarboxylation. Details of this will be published later on.

We record our thanks to Lt.-Col. S. S. Sokhey, Director, for his kind interest in these investigations.

K. GANAPATHI.
M. V. SHIRSAT.
C. V. DELIWALA.

Haffkine Institute,
Parel, Bombay,
February 19, 1942.

[1] Ganapathi, Shirsat and Deliwala, *Proc. Indian Acad. Sci.*, 1941, **14A**, 630.

[2] Lott and Bergeim, *J. Amer. Chem. Soc.*, 1939, **61**, 3593; Bergeim and Lott, *ibid.*, 1940, **62**, 1873.

[3] Ganapathi, Deliwala and Shirsat, *under publication.*

BIO-ASSAY ON TADPOLES OF THYROXINE AND SIMILAR PREPARATIONS

NUMEROUS methods have been proposed for the biological assay of thyroid and its preparations. Burn[1] has advocated two methods based respectively on (i) loss in weight and (ii) increase in CO_2 production of small laboratory animals on systematic thyroid medication. These methods, though accurate, are time-consuming and are not easily and conveniently carried out in small laboratories. Gaddum[2] suggested a method depending on the measurement of changes in length and in the metamorphosis undergone by tadpoles as a result of a 24-hour exposure to a solution of thyroxine. Wokes[3] has recently found evidence to indicate that the tadpole test is trustworthy and accurate and can yield results comparable with the metabolic tests generally advocated.

Prof. B. B. Dey of the Madras Presidency College prepared thyroxine from natural and artificial (synthesis from iodination of casein) sources and requested one of the authors (B. M.) to undertake the biological assay of these preparations. This gave an opportunity of employing the tadpole method of bio-assay for the first time under Indian conditions. From the results obtained, it appears probable that the method could be used on a more extensive scale. Barring the fact that the availability of the tadpoles is limited to a particular season of the year, this method does not seem to have any serious defects. The action on tadpoles is specific for thyroid-iodine under the conditions of the experiment (24-hour exposure only), as it is not influenced by potassium iodide, which was also tried. Quantitative estimation of potency is fairly satisfactory, provided sufficiently large number of tadpoles are employed for the experiments to enable a correct statistical analysis of data.

Two varieties of tadpoles (*Rana tigrina* and *Bufo melanosticus*), which are commonly available in Calcutta, were employed in this investigation. The 'Rana' variety seems to be more suitable for work, as this has a longer life-cycle and metamorphic changes can be better watched. The experimental details were

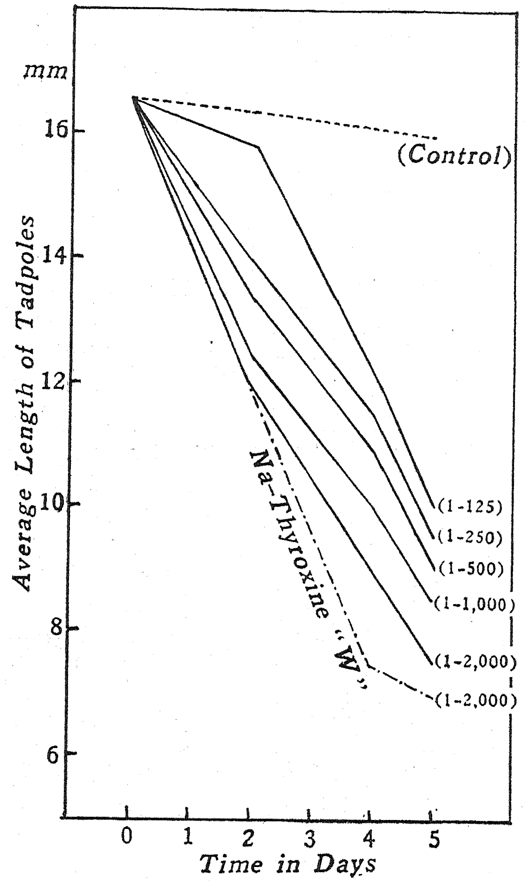


FIG. 1

FIG. 1. Effect of different concentrations of sodium thyroxine 'D' on average length of tadpoles (12 in each batch) after a 24 hour exposure. The dotted line (lower) shows the effect of sodium thyroxine 'W'. Concentrations are given in parts per thousand.

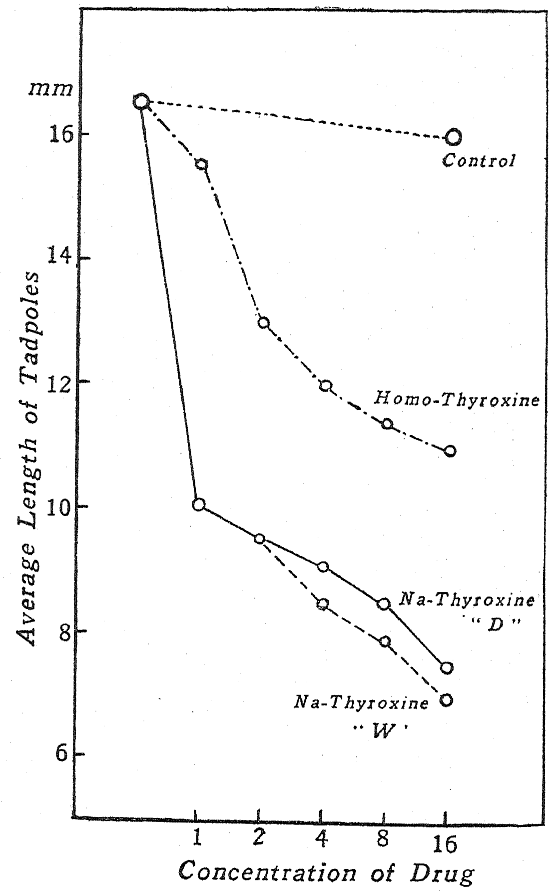


FIG. 2

FIG. 2. Comparative effect of sodium thyroxine 'W' and homo-thyroxine 'D' (synthetic). Exposure—24 hrs. Concentration—1 in 125,000. Average of 12 tadpoles in each batch. Time—5 days.

essentially those recommended by Gaddum and Wokes (*loc. cit.*). Minor modifications only were employed to suit the experimental conditions existing in the Laboratory. Twelve tadpoles belonging to the same clutch were used for each set of experiments. Thyroxine-sodium (B.W. & Co.), stated to contain 61 to 65 per cent. iodine, was used as the *standard* for comparison. The unknown samples tested were thyroxine-sodium prepared from desiccated thyroid gland (about 90 per cent. pure) and 'Home-thyroxine', prepared synthetically from casein (total iodine 34·8 per cent.).

The results obtained are plotted above showing *time-length* and *length-concentration* relationships of the tadpoles exposed to the various concentrations of thyroxine and homo-thyroxine for 24 hours. Normal controls and tadpoles treated with standard thyroxine-sodium (B.W. & Co.) are also shown. The photograph shows the stages through which the tadpoles pass to become fully developed frog. In this particular case, the metamorphosis has been brought about in 6 days what ordinarily should have taken 6 weeks to complete.

Pending statistical analyses of data, definite quantitative potencies of the natural thyroxine-

sodium and homo-thyroxine are not stated. Both preparations are however biologically active, the synthetic one being comparatively weaker in potency.

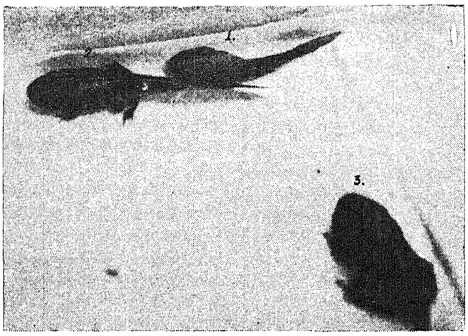


FIG. 3

Photo showing different stages of metamorphosis in tadpoles (No. 2 and 3) exposed to sodium thyroxine 'D' 10^{-6} for 24 hours: No. 1. Control tadpole. No. 2. Tadpole 3 days after exposure with marked protrusion of limbs, No. 3. Tadpole after 6 days showing shortening and extrusion of tail and looking like a miniature frog. The normal cycle takes about 6 weeks. ($\times$ 1·5.)

These and other results in this series seem to point to the fact that biological activity is probably more related to total iodine in thyroid preparations, rather than to thyroxine-iodine. This point is being more intimately investigated.

Our thanks are due to Prof. H. K. Mookerjee, Head of the Department of Zoology, University College of Science, Calcutta, for help in connection with securing the tadpoles and identifying them.

N. K. DUTT.
B. MUKERJI.

Biochemical Standardisation
Laboratory, Govt. of India,
110, Chittaranjan Avenue,
Calcutta,
February 18, 1942.

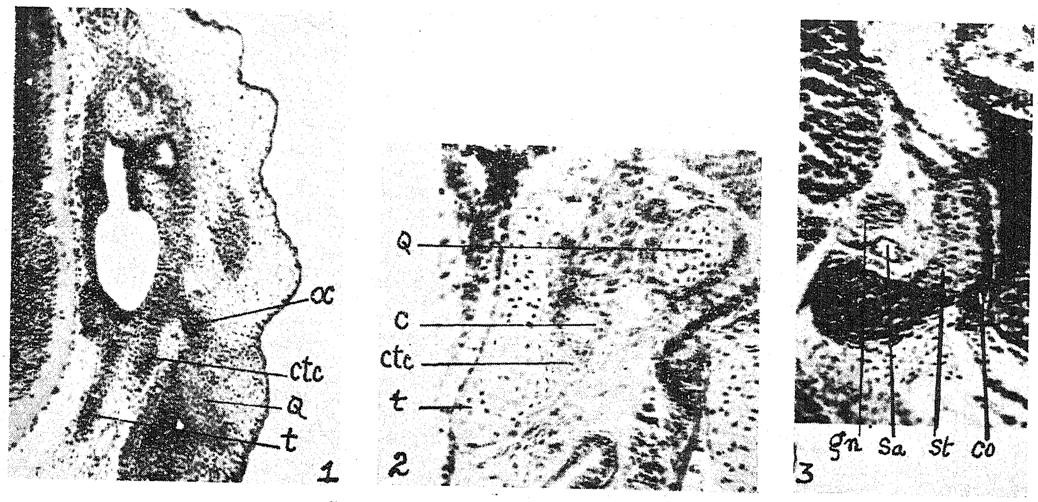
1 Burn, *Biological Standardization*, 1937, 118.
2 Gaddum, *J. Physiol.*, 1927-28, **64**, 246.
3 Wokes, *Quart. Pharm. & Pharmacol.*, 1938, **11**, 521.

THE STAPEDIAL CONNEXIONS IN *ICHTHYOPHIS GLUTINOSUS* LINNÉ (APODA)

PETER[1] described in *Ichthyophis glutinosus* (Linné) embryos a stapes consisting of two parts; an anterior club-shaped cartilaginous columella enclosing the stapedial artery, fused with the quadrate and therefore derived from it, and a posterior rod-like cartilaginous operculum lying in the middle of the large foramen ovale. The operculum was of independent origin. In addition, he described an independently arising cell strand (Fig. 11, st. dist.) separate from the columella-forming proximal *Anlage*, which united with the columella *externally* to form the 'distal end' of it. As regards the further fate of this, he noted that it formed first a joint with the quadrate while a part of it became connective tissue uniting the stapes with a projection of os Basale.

Marcus[2,3] described the operculum as capsular and the columella as hyoid derivatives in *Hypogeophis*, thereby differing from Peter. Further, he observed that the distal process referred to by Peter was really a tiny process at the bend of the columella and this could not naturally follow the quadrate since the columella was posterior to the former. Such a process was not noticed in *Hypogeophis*.

Having examined embryonic and metamorphosing stages of *I. glutinosus* (Linné), I am in a position to clear the discrepancy with regard to this distal process. Fig. 1 shows clearly the stylus columellæ in union with the quadrate; this corresponds to the proximal *Anlage* of Peter. Internally to this is another process which starts posteriorly as a thin strand of cells and continues anteriorly by the side of the quadrate and unites with the columella as seen in the figure. This process, corresponding to Peter's distal end of stapes, therefore, unites *internally* and not externally as remarked by him. In a slightly older stage (Fig. 2), this process bridges the trabecula and columella anterior to the quadrato-columellar connexion. In Fig. 3 (a stage later than Fig. 2), the connexion has degenerated into connective tissue still uniting the lower part of



Sections of I. glutinosus embryos

Figs. 1, 2, 3. *c.*—columella; *co.*—connective tissue bridge between stapes and otic capsule; *ctc.*—cartilaginous trabeculo-columellar connexion; *hn.*—hyomandibular nerve, *oc.*—otic connexion; *Q.*—Quadrate, *Sa.*— stapedial artery; *St.*—stapes; *t.*—trabecula.

otic capsule with the columella. This description of the final stage tallies with that of Peter, but he did not have the stage where the trabeculo-columellar union was noticed. This connexion is rather significant for we notice a similar one in *Hypogeophis*[4] (Figs. 3*a* and 9). The connexion in *Hypogeophis* is posterior to the otic articulation while in *Ichthyophis*, it is anterior, and therefore, Marcus, Stimmelmayr and Porsch[4] said that such a process was not discoverable in *Hypogeophis*. The trabeculo-columellar connexion seems to be peculiar to Apoda and as far as is known to me, is unparalleled in the vertebrate series.

L. S. Ramaswami.

Department of Zoology,
Intermediate College,
Mysore,
February 20, 1942.

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[2] Marcus, H., *ibid.*, 1910, **40**.

[3] —, *Anat. Anz.*, 1935, **80**.

[4] —, Stimmelmayr, E., and Porsch, G., *Morph. Jahrb.*, 1935, **76**.

[5] Ramaswami, L. S., *Nature*, 1941, **148**, 470.

SERRATIA SAMBHARIANUS: A NEW SPECIES FROM SALT LAKE OF RAJPUTANA

This new species of the chromogenic bacterium was discovered from the waters of the Sambhar Lake in Rajputana. Sambhar Lake is an inland salt-water formation fed by five saline rivers during the monsoon. It yields a large crop of sodium salts, including sodium chloride, which occurs in a far greater percentage as compared with sea water. This is, therefore, an economically important source of sodium chloride. However, the vast quantities of salt during the crystallisation of the brine turn reddish brown to red which decreases its value. Investigations were made to find out the cause of spoilation but it remained elusive for a long time. The senior writer was consulted by Dr. H. B. Dunnicliff, the Chief Chemist, Central Revenues, about this phenomenon as in his opinion it was due to the presence of some algæ in the water. The author carried out a series of experiments isolating each of the algæ but none was found to be a red colour producer. Ultimately, by employing the bacteriological technique and media he succeeded in obtaining chromogenic organisms belonging to Serratia group. The results were confirmed by

the joint author, who then independently carried out further investigations and concluded that it was a new species of Serratia which causes the "red heat". We propose the name *Serratia sambharianus* for this new organism.

This new species is much akin to *Serratia marcescens* Bizio. and *Serratia salinaria* Harrison & Kennedy but differs from both in various respects. *S. marcescens* cannot grow at 37° C., which seems to be its optimum temperature. *S. salinaria* grows in 16 per cent. to 30 per cent. salt but fails to grow beyond 30 per cent. salt, whereas this new species grows readily even in higher per cent. and relatively drier salt, which is really very remarkable.

The authors take this opportunity to thank Dr. H. B. Dunnicliff for his co-operation in enabling them to throw some searching light on this interesting problem.

S. C. Dixit.

Wilson College,
Bombay,

S. B. Vachha.

St. Xavier's College,
Bombay,

February 19, 1942.

A NOTE ON REARING THE LARVÆ OF THE MILK-FISH (*CHANOS CHANOS*)*

A study of the plankton present in the water of the Milk-Fish Farm was started from August 1941. On 11th August 1941, three larvæ found in the plankton, all of the same size (16 mm.), were successfully brought alive to the laboratory for rearing.

One of the larvæ was killed for immediate study. The following were the chief characteristics:—

(1) Transparent body with black eyes.

(2) Length, 16 mm.

(3) There were two rows of black pigments along the side of the body. On the caudal fin the pigments were scattered about; but there were no pigments on the other fins.

(4) The stomach and intestine were visible through the transparent body.

The other two larvæ were reared in a round glass-aquarium. As their body was transparent, the larvæ could be distinguished in water only with difficulty.

An aerator was used for the first ten days. The water in the aquarium was changed every day and fresh plankton was added every alternate day. After a few days the larvæ became so much used to the conditions of the laboratory that they seemed to recognise my coming by actively swimming towards me, especially in the morning at 8-30 A.M., when I supplied fresh plankton, on which they fed rather ravenously.

Within a week, the larvæ began to show signs of growth. The body began to lose its transparency. The dorsal side acquired a bluish tinge, which became more and more bluish as days passed by. The head became larger, and the body cylindrical. The ventral side of the body gradually became silvery. The larvæ became small fingerlings with adult characteristics in the course of a month.

One of the larvæ died on 18th September 1941 after living in the aquarium for over five weeks. Its length at the hour of death was 19 mm., the increase being 3 mm. The dorsal side of head and body was brilliant glossy blue in colour. The dorsal and caudal fins were blue; the pectoral, ventral and anal fins were white. The second larva died on 30th September 1941 after seven weeks. This larva also showed all the colour patterns noted above. Its length was 21 mm., the increase being 5 mm.

The larval characters noted above should enable a pisciculturist interested in rearing the Milk-Fish to distinguish its larvæ from other kinds of fish-larvæ.

P. I. Chacko.

Krusadai Biological Station,
Gulf of Mannar,

February 19, 1942.

* Published with the permission of the Joint-Director of Industries and Commerce, Madras.

EMBRYOLOGICAL STUDIES IN PALMÆ (A PRELIMINARY NOTE ON THE MEGASPOROGENESIS IN *ARECA CATECHU* LINN.)

THE review of literature on Palmæ given by Schnarf[1] and Schürhoff[2] reveals the paucity of work on the subject. There is considerable difference of opinion between different investigators about the mode of development. A re-investigation of several members of the family Palmæ is taken up by the author and a preliminary note on the megasporogenesis of *Areca catechu* Linn. is presented here.

There is a single basal, erect ovule in each ovary. The archesporial cell cuts off 4 to 6 parietal cells and the megaspore-mother cell becomes deeply placed. The development of the embyo-sac conforms to the Normal-type. The embyo-sac enlarges in size and the surrounding nucellar cells become disorganised constituting nutrition. Consequently the embryo-sac shows very irregular contour. The synergids are about the same size as the egg. The antipodals are persistent and become aggressive. The surrounding nucellar cells are depleted of their cell contents and the antipodals might be haustorial in function. The nuclei of the antipodal cells show marked hypertrophy.

B. G. L. SWAMY.

Bangalore,
February 25, 1942.

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A NEW PHANEROGAMIC PARASITE OF SUGARCANE IN BENGAL

THAT the sugarcane suffers from attack of phanerogamic parasites[1,2,3,4] is well known. The parasitic weed *Striga*, causing sometimes a good deal of damage in sugarcane crop, is not uncommon in India and in other countries. *Æginetia indica*, of the family *Orobanchaceæ*, has been known as a parasite on sugarcane in India and other tropical cane-growing countries, while a second member of the same genus, *A. paniculata*,[4] is reported from Burma as another parasite on cane. Though *Æginetia pedunculata* has been seen to occur as a parasite[1] on grasses, no such report of its parasitisation on sugarcane would appear to have been recorded so far.

During the months of June and July, 1940, many clumps of sugarcane were observed in some localities of the Munshiganj Sub-Division, Dacca, that were apparently suffering from some sort of disorder. The clumps were examined and clusters of flowers were found emerging out of the soil at the bases of the cane plants (Fig. 1). The flowers were later

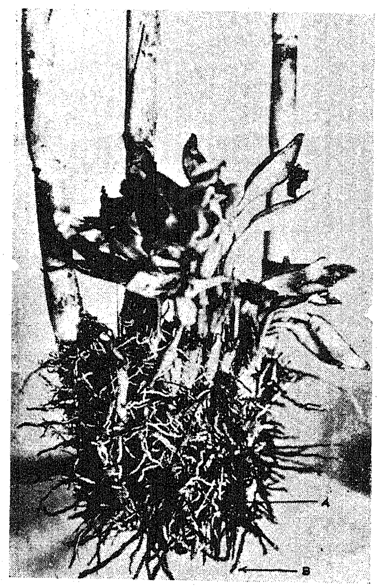

FIG. 1
Clusters of floral stalks and flowers of *Aeginetia pedunculata* showing attachment with roots of sugarcane. A—roots of the parasite; B—roots of sugercane.

identified to be of the species *Æginetia pedunculata* Wall.

To find out what relationship this flowering plant had with the diseased appearance of the sugarcane clump, the latter with the flowers was taken out of the ground with the root system intact and the whole carefully washed to remove the adhering soil. *Æginetia pedunculata* was found to produce a short, soft, thin underground stem, 4–6 inches long, having small fleshy scales over its body and to send out pedicelled (2 to 4 inches) flowers above

the soil surface. The flowers, 1½ to 2½ inches in length, were conspicuous by their bright violet colour and the aggregation of corymbs. Short rather stout and soft scapes, long bracteate pedicels, bright violet limbs, 2-lamellate placentas and mucilage loaded spathaceous calyx were all there to distinguish this species from *A. indica* Rox., the only other species of the genus known in India.

The roots of the parasite were found to form a thick tangled mass with those of the sugarcane. They formed organic connections with the thinner roots of the cane and thus drew upon the sugarcane host. Sometimes a knob-like swelling was seen upon the parasite root at the point where it formed connection with that of the cane. The attacked canes or clumps were stunted in growth with withered and dried leaves. In the early stages of attack, the outer leaves seemed to be affected first with withered edges and the midribs alone remaining green. In case of severe attack the clumps might die altogether. The effect due to the related species of this parasite on sugarcane is known as "bunga"[3] and the same name might be applied in this case also.

In the control of this parasite, the infected clumps should be dug out and eradicated as soon as the flowers become visible and before they form seeds. If the parasite is left to seed and the seeds, minute and numerous, mature then the parasite comes out in large numbers the next season. Setts for planting should be selected from fields free from the attack of the parasite. Further control measures are being tried, the results of which will be published in due course.

S. Hedayetullah.
J. C. Saha.

Section of Economic Botanist,
Agricultural Research Station,
Dacca,
February 9, 1942.

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[1] Hooker, J. D., *The Flora of British India*, London, 1885, **4**, 320.
[2] Luthra, J. C., *Agri. J. India*. 1921, **16**, 519.
[3] Roxas, M. S., *Sugar News*, 1927, **8**.
[4] Subramaniam, L. S., *Imperial Council of Agri. Research, India, Miscella. Bull.*, No. 10, 1936.

THE MANUFACTURE OF GLANDULAR PRODUCTS IN INDIA

While it is gratifying to note that several laboratories in this country have been making original contributions to the chemistry and therapy of Vitamins some of which are being quoted with appreciation in foreign scientific journals, it is to be regretted that few, if any, of our institutions have undertaken systematic research in the field of Hormones. This is probably due to some extent to the difficulties which are inherent in hormone-research but more to the fact that for such work to be really fruitful a better and more intimate co-operation between the chemist and the clinician is necessary than obtains at present in India. The incorporation recently of a department of Pharmacology in the Chemistry Department of the Institute of Science, Bangalore, is from this point of view to be regarded as a move in the right direction.

Glandular products like insulin, adrenalin, liver principles, pituitary concentrates and sex hormones have now become indispensable for the comforts of modern life, but we are at present entirely dependent on foreign imports for these essential drugs. The war of 1939 which has now blazed into a real World War has completely cut off our supplies of these medicinal products and we are consequently faced with the dire necessity of either developing our own resources or of going without these drugs. India is reputed to possess nearly a third of the world's population of cattle and it is the slaughter-houses of our principal cities which should mainly provide the raw materials for these drugs. Statistics obtained through the kind services of the Board of Scientific and Industrial Research in Calcutta show that nearly two and a half millions of sheep and goats and three and half lakhs of cattle (bullocks, buffaloes, cows and calves) are slaughtered annually in the cities of Bombay, Calcutta, Madras, Delhi, Karachi, Lahore, Lucknow and Dacca. These figures compare favourably with animals slaughtered in the slaughter-houses of London or even of a typical Packing House in Chicago.

The commercial manufacture of the important glandular products in India should not offer any insurmountable difficulties. I understand that investigations on the preparation of insulin are being vigorously pursued in the Bio-chemical laboratories of the Institute of Science, Bangalore, and the work carried on in my laboratory for the last one year on the preparation of the active principles of thyroid, and latterly of adrenal glands, has yielded results surpassing all reasonable expectations. The biological assay of such hormones as insulin, thyroxin and adrenalin which can be obtained in a pure crystalline condition is of course not a difficult problem and may be considered to be of only secondary importance, but in the cases of the other gland products like pituitrin, the anti-anæmic principles of liver or the sex hormones, strict biological control at every stage of the operations involved in their preparation is essential. The recently instituted Biological Standardisation Laboratory attached to the All-India Institute of Hygiene in Calcutta, appears to have excellent facilities, though on a small scale, for undertaking work of this nature. It is most to be desired that these facilities were improved and extended and arrangements made under which the active co-operation of this central laboratory with other chemical laboratories which may be recognised as important centres of hormone-research in India would be possible.

It would of course be very unreasonable to expect that factories on the lines of the Eli Lilly or the Lederlie laboratories in the U.S.A., or of the Boots laboratory in England, would emerge overnight as a result of these researches but there seems to be no reason why it should not be possible to make a beginning in the form of a pilot factory preferably in a central place in India which might very soon be in a position to supply at least the urgent war-time demands in the country.

B. B. Dey.

Presidency College,
Madras,
February 25, 1942.

ON AN "IMPROVED METHOD FOR THE DETERMINATION OF PROTHROMBIN TIME"*

The real question, in my view, is whether the change in the technique (preparing the solution of thromboplastin, be it from rabbit's brain or from venom in calcium chloride instead of having two separate solutions and adding calcium to the mixture of plasma and thromboplastin) does really shorten the prothrombin time as a rule. A fuller record of results could not be included in a short note. In our experience there was no shortening at all, when the test was done using thromboplastin from rabbit's brain and following the technique of the improved method, namely, preparing the thromboplastin in calcium chloride, thus increasing the concentration of prothrombin in the reaction mixture and also bringing the calcium and thromboplastin together before adding to the plasma.

A minor consideration is whether the reduction of prothrombin time to the extent of 8 seconds is an advantage to the laboratory worker and even if it is considered so, are the results likely to be as accurate as with 'prothrombin time' determined according to Quick's method?

D. V. S. Reddy.

Andhra Medical College,
Vizagapatam,
January 19, 1942.

* *Cf.* this Journal—1941, **10**, 326 ; 1942, **11**, 60, 61.

INDUCTION OF POLYPLOIDY IN CROP PLANTS

BY

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(*College of Agriculture, Poona*)

CYTOLOGICAL studies have shown that about half the species of investigated angiosperms are polyploids, as inferred from the presence of chromosome numbers in multiples of that found in some related species. While this is the condition in nature, the attempt to artificially induce polyploidy has met with any marked success only recently. The investigations of Blakeslee and Avery[1] have shown that of the many methods tried to uniformly double the chromosome number and thus obtain seeds with the doubled number, the application of the alkaloid colchicine is by far the best. Extensive work in this new field is in progress in America (Blakeslee[2]). But so far we have come across only five reports of successful application of colchicine on Indian crop plants (*cf.* Pal and Ramanujam[3]; Amin,[4] Richharia and Persai[5]; Pal, Ramanujam and Joshi[6]; and Ramanujam and Joshi[7]).

The present note deals with the technique adopted in inducing polyploidy in *Phaseolus radiatus* L. (*mug*) and a comparison between the diploid and tetraploid. Similar studies on a number of other crop plants are in progress.

Technique.—In the application of colchicine various methods are used (*cf.* Derman[8]). The optimum dosage and the best method of application of the drug varies from species to species. We tried different methods of applying colchicine with varying degrees of success.

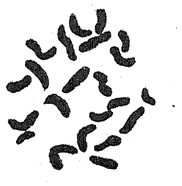
The method we found most successful with *mug* was applying 0·4 per cent. colchicine in agar to the apical bud after the first pair of leaves had developed. This treatment stunts the growth of the bud considerably and its development is delayed very much. By treating in the above manner we got four plants out of twenty definitely tetraploid, while from some others not examined critically, a mixture of diploid and tetraploid seeds may be expected. Examination of epidermis of strictly comparable leaves (the first fully opened leaf below the apical bud in comparable branches) showed that in at least one plant octoploidy had resulted.

Seed treatment was not successful; the chief cause of failure appeared to be the drastic effect of the drug on roots, which failed to produce lateral roots or to show any appreciable development after treatment.

Cytological Examination.—Chromosome counts were made from root tips obtained from seeds of the artificial tetraploid (as determined earlier from pollen examination) and from the diploid controls. As the number of first generation tetraploid seeds was small, the germinated tetraploid seeds from which root tips were taken were carefully planted in earthen pots and they developed into vigorous tetraploid plants and produced a number of pods.

In the cells of the diploid there are twenty-two chromosomes while in the tetraploid there are forty-four chromosomes. Figs. 1 and 2 are Indian ink drawings made on photomicrographs showing metaphase plates from root tips of the diploid and tetraploid respectively. Two satellited chromosomes were seen in the diploid complement, though due to the smaller size of the chromosomes, the four satellited chromosomes which should be expected in an auto-tetraploid were not distinguished in the cells of the tetraploid. But prophase nuclei showed four chromosomes attached to the nucleolus. Also the nucleolus in the tetraploid is much larger than in the diploid.

In certain characters tetraploids differ from diploids and these are of value in detecting polyploids without actual chromosome counts. In tetraploids the leaves are thicker with larger cells and plastids compared with diploids. This gives the leaves a distinctly greener appearance and is a fairly accurate guide in distinguishing affected branches from unaffected ones, especially where sectorial chimeras have arisen as a result of treatment. Epidermis from strictly comparable leaves show an increase in size of cells and stomata



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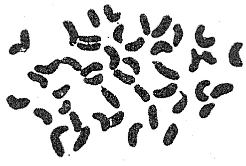

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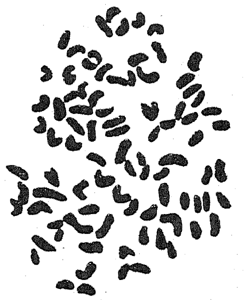

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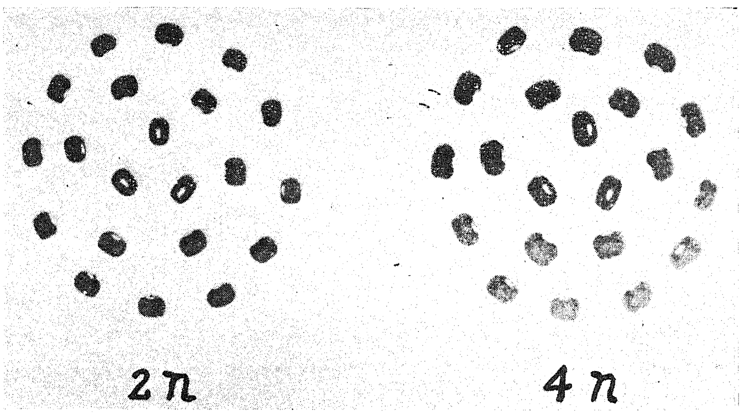

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FIGS. 1-3.—Metaphase plates from root tip cells of the diploid ($2n = 22$), of the tetrapoid ($4n = 44$) and of a sectorial chimera ($8n = 88$) respectively. × 2400. Drawings made from photomicrographic prints.

FIG. 4.—Photograph of seeds from diploid ($2n$) and tetraploid ($4n$) to show the increase in size of seeds as a result of chromosome doubling (Nat. size).

in the tetraploid while the number of cells is less. Pollen size, which is a surer index of ploidy, has invariably shown that there is an increase in size of pollen grains with increase in chromosome number.

Consequences of Auto-polyploidy.—Natural as well as artificial polyploids are distinguished from their diploid progenitors by the presence of *gigas* characters—thicker stem, greater vigour, thicker leaves with darker green pigmentation and larger flowers and seeds. However, in colchicine induced polyploids, in the first generation, the plants are more stunted than the diploids. This is evidently due to some inhibiting effect of the drug. But in the second generation, the offspring from tetraploids showed much greater vigour and appeared more hardy than diploid controls. We have found that in both the first and second generation tetraploids, the seeds are distinctly larger than those of the diploid (Fig. 4).

In chemical constitution also the tetraploids show many differences. Sansome and Zilva[9] have found that tetraploid tomatoes have twice as much vitamin C as the diploid. Randolph and Hand[10] found a tetraploid strain of maize to contain 43 per cent. more carotinoid per gram of dry meal than the corresponding diploid. This shows the possibility of increasing the nutritive value of plant products by doubling the chromosome number. Studies on the food content of the tetraploid seeds will be undertaken as soon as sufficient seeds have been procured in the third generation.

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REVIEWS

Landscape. By C. A. Cotton. (Cambridge University Press, London), 1941. Pp. xviii + 301. Price 21/.

This book makes a systematic study of the various forces which are at work shaping the earth's surface, and by means of a really excellent series of line drawings of actual models, shows most vividly how an infinite variety of landscape features can be produced.

Much that has been written recently about soil erosion gives the impression that it is a new development, which of course is wrong. The *pace* of erosion has been undoubtedly altered by man's actions, but erosion is actually one of the oldest factors in the fashioning of land surfaces. It has in fact been at work since the first land surface appeared out of the ocean. Uninterrupted erosion of any raised land mass would tend to reduce that surface to one continuous plain sloping gently to sea level, but this is counteracted by intermittent geological uplift by which new areas are raised up. Some parts of the earth's surface have been worn down over and over again in the course of geological time. No feature of landscape is a finished form; mountains themselves are transient forms when considered in terms of geological development.

For anyone who travels much in India this book will repay study, for the familiar features of plain and mountain and coast all appear in easily recognisable form, and immediately take their place in the geographer's deductions. The reader becomes Dr. Watson to the author's role of Sherlock Holmes as he unravels the fascinating story of how such freakish features of landscape have arisen as bad-lands, tors, hoodoo columns, earth pillars, pot-holes in stream beds, buttes, rock bridges, and so forth. Starting from the simplest geological form of a gently raised and slightly undulating countryside, as when a coastal plain first becomes dry land, the author develops logical reasons for the apparent vagaries of nature when she produces such things as the capture of one river's drainage by another, or the immensely deep gullying along river banks such as we see in the Betwa and Chambal ravine areas of the Jumna basin, and the amazingly intricate patterns of curves which a river can produce during its meandering across a plain.

Although most of the author's actual examples are culled from New Zealand, Europe, Japan and the western states of the U.S.A., the basic characteristics of land sculpture by normal erosion processes are so clear that one is constantly meeting formations that can be recognised as Indian. Of the various chapters possibly that of most interest to India is on the meandering of rivers, though the author does not follow it far enough into the flat plains to satisfy the irrigation engineer.

Another omission, if one may be permitted to indulge in a little constructive criticism, is that actual desert conditions are hardly referred to, and none of the photos or diagrams depict a desert or the freak landscapes which are found where wind plays endlessly with desert sand. The man-made sand dunes of the west coast of France, possibly the greatest single contribution so far achieved by land planners, is not mentioned, though hundreds of square miles both north and south of Bordeaux estuary have been transformed from malarial swamps into vineyards and pine forests sheltered from Atlantic gales by these artificially created dunes.

In discussing run-off and the fate of rain, one would have liked to have something more definite than: "Not all the water with which rivers are fed reaches the sea", and thereafter the enumeration of evaporation and soakage in river beds as accounting for such losses. Actual corrosion (or mechanical cutting and scouring of its banks and bed by a river) is many times greater in floods than at ordinary levels, so the measure of a river's capacity to produce heavy floods is to some extent a measure of its capacity to alter the landscape. In this connection some reference to the various attempts to locate and assess areas of serious erosion within important river catchments in America and India would have been apposite. Also a fuller description of bad-land topography and the conditions under which it develops would have been of value; this is dismissed in a few

words, and the single photo given for this feature is not at all typical.

One further word of criticism is that in the discussion of the movement of massive boulders along river beds, no emphasis has been placed upon the enormous powers for mischief possessed by mud flows as compared with mere water power. In many Himalayan valleys one meets isolated boulders weighing perhaps as much as 300 tons, which could not conceivably have arrived where they are by means of water action or gradual undercutting and rolling. The answer invariably is to be found in the thick and porridgy mud-flows which follow any major land-slide. These act like a cement cushion on which enormous weights can be moved for long distances before being deposited.

Apart from such minor points, which do not really detract from the value of the book, we should appreciate Professor Cotton's contribution to the study of landscape as being of the greatest value, not only to those engaged in geology and geography, but also to the average thinking citizen who prides himself on knowing the reasons for what he sees around him.

R. MACLAGAN GORRIE.

The Second Year-Book of Research and Statistical Methodology (Books and Reviews). Edited by Oscar Krisen Buros. (The Greyphon Press, Highland Park, New Jersey), 1941. Pp. xx + 383. Price $5.00.

This is the author's second attempt, the first one being his similar compilation in 1938, at giving to persons interested in statistics a resume of reviews on books containing statistical methodology and other allied topics. As noted by the author in his Preface the book mainly aims at helping students, teachers and librarians to select text-books with greater discrimination, to point out to them weak and strong points of particular books as also the marked differences of opinion among the more advanced students of statistical theory, to raise the standard of reviews and incidentally the standard of books on statistics, etc. One has only to look to the exhaustive periodical directory and Index, appended towards the end of the book to appreciate the amount of labour put in with a view to achieve these ends. Going through the details of the excerpts published, one finds that they have been chosen very carefully, representation being given to favourable reaction of reviewers as also to their adverse criticism. Although the book is a massive collection of reviews, it is by no means devoid of interest to the general reader interested in studying different trends of thought in various branches of statistical science.

For an Indian reader, one of the chief shortcomings of the present volume is the omission of references to well-known journals in India. For instance, there is no reference to the important quarterly, *The Indian Journal of Economics*, running in its 22nd volume, as also to *Science and Culture*, a popular scientific monthly, of about seven years standing. *The Indian Medical Gazette*, which has a wide circulation outside India, is another notable omission. The reviewer feels confident that if co-operation is sought from such periodicals it will be certainly forthcoming. As a result of this some good Indian books containing statistical information which have been favourably reviewed outside India, do not find a place in this compilation. Dr. Gyan Chand's *India's Teeming Millions*, Prof. Radha Kamal Mukerji's *Planning Food for* 400 *Millions* and Dr. Rao's *India's National Income*, are few of the notable omissions.

One of the several improvements over the 1938 compilation according to the author is that the excerpts presented in this Year-Book are longer and more informative than those in the first volume. It seems to the reviewer that some of the reviews incorporated here are unnecessarily long. Many of them run into three columns whereas a review on Hull's *Mathematic-deductive Theory* is longer still and another on Burt's *The Factors of Mind* occupies as much as seven columns. One, therefore, naturally feels the necessity of fixing an upper limit as well to the reviews reproduced if that could be done without loss of valuable information. Reviews of the same book by the same person in two different periodicals have been reproduced (Ref. p. 111, col. 2). This should be avoided especially when such space could be better utilized.

In the future compilations of this type the author has promised to introduce a section devoted to non-critical abstracts of voluminous periodical literature in statistical

methodology. This will certainly be a welcome improvement especially because former attempts in this direction like Dr. Irwin's *Recent Advances in Mathematical Statistics* and Wishart's *Bibliography of Agricultural Statistics* published in the Journal of the Royal Statistical Society were favourably received by statisticians and were highly useful to research workers. But the reviewer is afraid that such a publication will occupy a lot of space in view of the growing volume of literature in this subject, even if it is restricted to papers written in English.

Looking to the reviews on the 1938 Year-Book, published in this volume, the reviewer is satisfied to find that the author has incorporated almost all the useful suggestions given by the previous reviewers. There is, however, one which seems to have escaped the author's notice and that is the classification according to subject. Such an Appendix along with others given in the present volume will be very useful.

B. N. DATAR.

A Text-book of Intermediate Physics (in Tamil). Vol. I. By R. K. Viswanathan, M.A., and V. N. Ramaswamy, B.Sc. (Hons.), Annamalai University, 1941. Pp. lxxi + 686.

The problem of scientific terminology in Indian languages is a very live one, and has recently been ably discussed in a leading article in *Current Science* (October 1941, 10, No. 10, p. 425). The immediate objectives are two, first the dissemination of the trends in modern scientific ideas and achievements among the general public so as not only to make them appreciate the benefits but also to co-operate intelligently in the wide and beneficial application of the scientific principles in present-day life and civilization. The other important objective is to help in the teaching of the basic principles of science to the school boys, the majority of whom must inevitably take to various professions after their general school education. There is yet another possible objective, namely, provision for advanced study in undergraduate classes, and for independent research in science through the medium of the Indian languages. This is not necessarily a "logical extension" of the former objective, as claimed in the brief preface to the book under review. Those in the research field are feeling already the barriers to intercommunication of ideas—so necessary for rapid advance and avoiding of wasteful duplication of work—on account of the various attempts during the last decade at publishing Journals in other European and Asiatic languages than English, German and French. If still, there is to be any development towards this third objective, it should be nothing short of an all-India uniformity and approximation to international phraseology.

The book under review on "Intermediate Physics" is written in free Tamil, and may be regarded as an aid to the more advanced general science education in the pre-university classes. It is indeed a laudable achievement. The get-up of the book is good, and the planning and presentation of the subject are along the routine lines. Almost all of the scientific terms coined have the desirable qualities of simplicity, precision, euphony and above all intelligibility and are deserving of wide currency. The book is, however, defective in one important feature, *viz.*, lack of any good diagrams. As active teachers, the authors must no doubt be aware that diagrams are just as important as the language to convey the ideas across to the students and must be given the same careful consideration of simplicity, precision and intelligibility. Such diagrams as of the Bunsen ice calorimeter with the right-angled bends of the capillary tube, the "giant" test tube and "magic" retort stands of Fig. 204 on page 639, the "pestle" like thermometers on page 471, and the "floating" stopper in Fig. 197, are typical of the glaring defects in all the diagrams. There are but few typographical errors; incidentally the authors use throughout italic *c* instead of capital C for the Centigrade scale. These and similar defects must be remedied in future editions, if the value of this otherwise excellent book must be kept up.

M. A. G. RAU.

Diffusion in and Through Solids. By R. M. Barrer. (The Cambridge University Press, London), 1941. Pp. x + 464. Price 30 *sh*.

The study of diffusion touches upon numerous aspects of physico-chemical research, and is of fundamental importance for the large number of problems involving transfer of materials by diffusion from one phase to another that are repeatedly

encountered in Chemical Engineering operations. The book under review is, however, confined to the study of diffusion in and through solids, a subject which presents a whole set of new phenomena and is frequently composite in character on account of the possible interactions between the diffusing material and the diffusing medium. These studies should be also of great help in understanding the fundamental nature of the technically more frequent phenomena of diffusion across stationary fluid films, a topic which does not fall immediately within the scope of the title of the book.

The author deals with the several processes of permeation, solution and diffusion in solids, the theories concerning their interpretation being balanced by an adequate description of the experimental methods and results. The first chapter gives a number of solutions of the diffusion equation suitable for treating the various diffusional problems that may arise. Chapters 2, 3, 4, 5, 9 and 10 deal in detail with the diffusion of gases and vapours through a variety of inorganic and organic structures. This covers the technically important subject of uptake and evolution of gases by metals, and the numerous studies made of gas flow through rubbers, fruit and food wrappings, insulators, leathers and paint and varnish films. Chapters 6, 7 and 8 describe the phenomena of conductivity and diffusion of ions and atoms in ionic lattices, metals and surfaces. These involve a knowledge of equilibria between holes, interstitial ions, and normal lattice and other structure sensitive factors. Such fundamental studies are capable of yielding much information on phenomena such as annealing, age-hardening, plasticity, recrystallisation and alloy transformations.

Throughout the book, adequate numerical values of permeability and diffusion constants for various systems have been collected and listed in the relevant chapters to serve as reference material. On the whole this book is a valuable addition to the Cambridge Series of Physical Chemistry.

M. A. G. RAU.

Dipole Moments in Chemistry. By Dr. M. A. Govinda Rau. (The Registrar, The University of Madras), 1940. Pp. 64. Price As. 8.

This is a reprint from the *Journal of the Madras University,* Vol. XII, No. 2, 1940, and is the subject-matter of a series of three lectures delivered under The Sir Subramanya Ayyar Endowment scheme of the Madras University. The author has himself worked extensively on the subject, and has made some very definite contributions to the advancement of our knowledge on Dipole Moments, and their bearing on the structure of Chemical Molecules. This subject covers a field in which both physicists and chemists are deeply interested. The first lecture reviews in an effective and elegant manner the physical significance of dipole moment measurements, and the experimental technique. The second lecture is a lucid exposition of the relation between dipole moments and the structure of molecules and is developed on extremely interesting lines, while the third lecture deals with the complex subject of dipole moments and chemireactivity.

This publication makes available to all those interested in the subject a very stimulating and helpful account. There is a choice Bibliography covering the subject up to 1939.

Shells and Other Animal Remains Found on the Madras Beach. By F. H. Gravely. (*Bulletin of the Madras Government Museum*. Natural History Section: Vol. V, No. 1), 1941. Pp. 112. Price Rs. 3–2.

In writing this memoir the author has made a valuable contribution towards our knowledge of the coastal fauna of Madras. It has been written in such a way that it satisfies the needs of not only a student of Zoology but also a layman interested in the natural history of coastal animals. As the author himself points out, the object in writing this book has been to interest and help the casual collector rather than the specialist. As far as possible technical terms have been replaced by simpler ones. All the forms have been classified and arranged in a systematic manner from Protozoa to Chordata. Under each phylum, the common forms are described in simple terms illustrated with figures. Wherever necessary, key for the identification of the genera and the species has been given. At the end, a list of identified genera and species of the Madras Beach has been given together with references to the literature pertaining to these animals.

One who has been in charge of the

teaching of Zoology in any of the Indian Universities will greatly appreciate the value of this memoir. The specimens of animals collected on the seashore by parties of students are not often used to the best advantage for want of adequate and ready literature for the identification and study of the forms. This *Bulletin* will prove to be a valuable guide both to the casual collector and advanced students of Zoology in their study of the shore fauna.

B. S. B.

Ramalinga Reddy Sastyabdapurti Commemoration Volume: Part I—Sciences. (Andhra University, Waltair). Pp. vii + 234. Price Rs. 10 or 14*sh.*, postage extra.

The articles that were presented to Sir C. R. Reddy by scientists from different parts of India on the occasion of his *Sastyabdapurti* are published by the Andhra University in a collected form. This volume contains two papers dealing with physics, fifteen papers dealing with chemistry and chemical technology, one dealing with surgery and three dealing with mathematics. A photograph of the bust of Dr. C. R. Reddy which was made by Mr. D. P. Roy Chowdary and unveiled by H. E. Sir Arthur Hope and three portrait sketches of him prepared by Mr. K. Ram Mohan Sastri are also reproduced in this volume.

The volume opens with a paper by Sir C. V. Raman and Dr. N. S. Nagendra Nath in which is given a self-contained theoretical exposition of the new type of X-ray reflections. This subject has recently been investigated in great detail at Bangalore and is now attracting the attention of several prominent physicists. This is followed by an article in which Dr. I. Ramakrishna Rao describes the many interesting properties of water and shows how they can be accounted for by considering the complex structure of this liquid. In the next two papers, Dr. H. K. Sen and Dr. J. C. Ghosh deal respectively with the planning of Scientific and Technical Research in India and the War and its Repercussions on the Chemical Industries in India. Nitrogen fixation, photosensitization, chemistry of medicinal oils, of the constituents of lichens, of the bitter principles of some fruits, etc., are amongst the subjects dealt with in some of the other papers. A brief account of the evolution of aseptic surgery since the time of Pasteur and Lister has been given by Prof. M. G. Kini. The last three papers of the volume, which are devoted to mathematics, respectively deal with some fundamental limits in analysis, Liouville's theorem and a theorem of Estermann in the additive Prime Number Theory.

A perusal of the names of the authors that have contributed to this volume shows that many distinguished men and specialists from all over India are amongst them. The subjects dealt with, cover a wide range of interests and this is a clear indication of an active era of original scientific work having started in this country. It is gratifying to note that the sale proceeds will be utilized for the benefit of the Andhra University. The volume will be a welcome addition to one's library both as a compendium of useful work and as a reminder of the esteem in which an eminent educationist like Dr. C. R. Reddy is held by the several contributors to the volume. The printing is good. The get-up is rather simple but could have been more attractive. S. B.

Punjab Irrigation Research Institute: Report for the Year ending April 1939. (The Punjab Irrigation Research Institute, Lahore), 1940. Pp. 189.

The Research Institute, during the year under report, undertook a number of investigations of engineering interest.

Soil profiles of the Punjab Alluvium were examined and in no case a rising water table was found to pierce the soil crust which generally overlies a sand stratum. In an unirrigated area, the top five feet of crust was found to have the greatest variation in salt and even when salt had very large vertical movement, it was found to have very little lateral movement.

In the case of earth roads, moisture largely contributed to the preservation of road surfaces and prevention of dust nuisance. Salt in the soil is an important constituent determining the moisture content of a soil, the hygroscopicity of a soil increasing with increasing salt concentrations. Sodium chloride has been found to be valuable in promoting moisture retention, while sodium sulphate, even in small quantities, has been found to disrupt the surface. Cohesion in dry soils depends on the clay content and the fineness of particles. The effect of exchangeable bases on soil cohesion

was found to be a maximum when the soil was dry and the order of cohesion for the dry soil followed the order of dissociation for the ions, *i.e.*, Li > Na > K > Mg > Ca.

An apparatus for measuring the capillary force of sand was devised which also serves for a rough and ready determination of the mean diameter of sand. Experiments have not indicated that the discharge of a tube-well is proportional to the area of the strainer, but there appears to be an optimum size of the shrouding material with respect to the grade of the water-bearing sand. An attempt has been made to detect cavities under weirs by means of an apparatus causing vibration by impact, the amplitude of vibration being naturally greater for unsound work.

A mud plaster, non-erodable under rainfall or flowing water has been got at, by the addition of 5 per cent. cement by weight to the Punjab soil generally containing about 15 per cent. of clay. Lining of some minors and water courses on two large farms with mud plaster, has considerably reduced leakage.

Factors contributing to the formation of Thur were studied during the year and several areas were taken for reclamation. Data were collected regarding the discharge of open wells, water requirements of crops and cost of this form of irrigation. It has been shown that generally a farmer gets a higher profit per acre on the introduction of tube-well irrigation than in the case of open well irrigation.

Frictional drag exerted by different grades of sand bed on the flow of water in a channel, and movement of silt in a tilting flume are being studied. Examination of the hydraulic observations on the Mississippi river published by the U.S. Waterways Experimental Station, Vicksburg, has shown that the slope-discharge-silt formula of the Irrigation Research Institute agreed well with the observed values.

Experiments on a model of the river downstream of Panjnad weir with a view to control erosion indicated that a two T-head spurs properly disposed would arrest erosion. Work is also in progress on models of the River Chenab in connection with problems connected with river training and silt entry into canals. Silt surveys of the Upper Bari Doab Canal, the Lower Chenab Canal and the Western Jumna Canal were also undertaken.

After a small shower of rain or after irrigation, a rise in water-table much greater than can be accounted for, takes place. A study is being made to determine the cause of this phenomenon, probably the result of negative pressures developed in water films surrounding soil particles. A survey of wheat soils with reference to yield and the chemical constituents of the soil indicates that soils having a high yield of wheat have a low manganese and high available phosphate content.

The Research Institute has been engaged during the year on a variety of useful and important engineering problems.

C. GOPALAKRISHNAN.

The Indian Cotton Textile Industry (1941 *Annual*). (Gandhi & Co., Calcutta), 1941. Pp. 150. Price Rs. 3 or 9*sh.*

The 1941 Annual of the Indian Cotton Textile Industry has been published by Messrs. Gandhi & Co., and is a handy and useful reference book for all that are engaged in the cotton textile industry. As in the previous year, the statistical figures for imports and exports of cotton, yarn and cloth are incomplete as their official publication is withheld owing to war conditions. The various details are arranged in a systematic and clear manner as in previous issues of the Annual.

A more detailed survey of the working of the Handloom Weaving Industry in various Provinces and States might, perhaps, have been much appreciated, particularly in view of the fact that the Handloom Weaving Industry occupies such an important part in the economics of the Indian cotton industry and is passing through a period of acute depression for want of adequate supply of yarn and other raw materials at reasonable prices.

B. K. MURTHY.

PROGRESS OF AGRICULTURAL RESEARCH IN INDIA

Annual Report of the Imperial Council of Agricultural Research, 1940-41. (Manager of Publications, Delhi), 1942. Pp. ii + 190. Price Rs. 2-12-0 or 4*s*. 6*d*.

THIS is the eleventh annual report of the Imperial Agricultural Research Council since its inception and summarises the main features of the work of the year. Nearly all the research schemes of the previous year have been in progress and many other schemes were sanctioned during the year and others have been under consideration. The schemes under agriculture proper have related to nearly every aspect of the main classes of crops and number as many as fifteen with a budget allotment of about Rs. 56 lakhs. Work on rice has mainly related to the trial of varieties suited to different conditions, distribution of seed of improved varieties, the publication of a summary of the results of manurial experiments on rice and so on. Of scientific interest are the conclusions that any rice variety can be made to flower within 60 days of sowing by 'light' treatment, that ordinary rice varieties can be made suitable for growing on salt lands by treating the seeds with a dilute solution of salt, and that scent in rice behaves as a simple recessive character. Work on the striga pest was continued but has led to no important practical result. A new scheme was sanctioned for research on the pulse crops—a step long overdue, we should think. A good deal of work has been done on the different oil seed crops, including coconuts and action has been taken to popularise cotton seed oil cake as a cattle feed. It is gratifying to note that one dozen mills have been started in the Punjab for the extraction of cotton seed oil and a large plant including an oil refinery has been started in Hyderabad (Sind).

In tobacco, the co-operative flue-curing scheme came to a close in the year and though the work was not all that was expected, it has demonstrated that high grade cigarette tobacco can be grown successfully in Nadiad, Jullundur, Sabour, Balaspur and Warangal. In the section of Horticulture, the cold storage schemes have yielded excellent results worthy of being adopted on a commercial scale, and so have the schemes on fruit preservation. We should like more attention being paid to the diseases and pests of fruit trees, as it is in this field that the cultivator looks for relief to scientific research. The prevalence of the codling moth in apples coming into India, is reported and it is a question for consideration if the imports of such fruits into free areas like Bangalore or the Nilgiris should not be prevented or controlled.

Schemes relating to Animal Husbandry alone and in combination with agriculture were twelve in number with an allotment of Rs. 25 lakhs. Among the schemes sanctioned in the year, two are of considerable interest both scientifically and practically, *viz.*, one relating to the transmission of genetical factors in cattle, another to the artificial insemination of livestock. Several sheep-breeding schemes were in progress though with no outstanding results. A scheme for breeding Angora goats was sanctioned in the year. All feeding experiments have stressed the great value of berseem with meth (menthya) as the next best; groundnut oil cake has been found richest in digestible protein and deserves much wider use. Disease investigation has rightly received great attention; the spread of tuberculosis and Johne's disease is noted with alarm and the need for proper control measures has been emphasised. Very little progress has been made in milk recording and in pedigree registration. The question of the supply of milk from villages to towns was discussed in all its aspects and a number of appropriate recommendations have been made. There was a large increase in the number of stud bulls, to the extent of 30 per cent. Schemes for grassland improvement and mixed farming were sanctioned during the year, as well as several for the improvement of poultry and for pisciculture. We wish that the Council had stimulated the preparation of shark oil with some more direct financial and other aid than it appears to have done. Schemes on sugarcane and sugar research, agricultural marketing and cold-storage have all much useful work to show.

On the publication side the event of the year is the publication of *Indian Farming* which has been started as a popular monthly Journal and which keeps up a high level of excellence.

A. K. Y.

GUJARAT PREHISTORIC EXPEDITION

A PRESS COMMUNIQUE from the Director-General of Archæology in India states:—

The Archæological Department has recently organised an Expedition for the study of the prehistory of Gujarat with the co-operation of a number of institutions and scholars. Although the Department has hitherto organized systematic work on a large scale at sites belonging to the historic and prehistoric periods, particularly in Northern India, the occurrence and sequence of the earlier stone age cultures were not brought within the purview of its activities. Much interest has recently been taken in this subject, particularly since the British-American Expedition led by Dr. de Terra of the Yale University worked on the Ice Age and connected human cultures in North-West India and other areas. The Archæological Department has now in hand a Bibliography of South Indian prehistory, with a view to serve as the basis of future work. The pioneers of research in India's stone age

were geologists, particularly R. Bruce Foote, who, over 50 years ago, found palæolithic implements in Peninsular India so far north as Gujarat. One of the problems stated by Bruce Foote concerns the age of the palæolithic culture in the Sarbarmati valley and the gap or distance in time between that and the neolithic or later stone age culture. This has now been investigated by the Gujarat Prehistoric Expedition organized by the Archæological Survey.

The area chosen for this year's work is the Baroda State and parts of the Sarbarmati valley which lies in the Vijapur Taluka and of the Narmada valley in the Sankheda region have already been surveyed. On the Sarbarmati the examination of the river bed for a length of nearly 25 miles has yielded hundreds of specimens of quartzite implements, mostly found embedded in the pebble conglomerate formation. The age of these deposits is indicated by the fact that nearly 80 feet of alluvial deposits and blown loess overlies the original river bed forming the habitat of early stone age man. This roughly indicates the age as some 50,000 years. Besides these early stone age finds, a number of microliths or tiny stone implements left by man have been recovered from the top strata of the loess hills. In the valley of the Narmada and its tributary the Orsang besides microlithic finds, palæoliths have also been discovered for the first time.

Thanks to the ample facilities afforded by Sir V. T. Krishamachari, the Dewan of Baroda, it was possible for the Archæological Department to extend this expedition to Baroda State. Two scholars especially trained in prehistory have been engaged by the Department, and the Deccan College Post-Graduate and Research Institute, Poona, lent the services of its Professor of Ancient Indian History. The Baroda Archæological Department, the Gujarat Sahitya Sabha and the Gujarat Research Society have also co-operated. The results obtained so far have considerably advanced the scientific knowledge of early man in India, and it is hoped that if this enterprise is continued on a systematic basis the story of India's earliest inhabitants would be better known and a chapter of human endeavour in its earliest form unearthed from the fruitful banks of India's rivers.

CENTENARIES

Shrapnel, Henry (1761-1842)

HENRY SHRAPNEL, the inventor of the shell bearing his name, was born at Bradford-on-Avon 3 June, 1761. He received a commission as second lieutenant in the royal artillery in 1779. He saw service in Newfoundland, Gibraltar and West Indies. He became first assistant inspector of artillery in 1804, colonel in 1813 and major-general in 1819 and retired in 1825.

Between 1784 and 1804 he made many experiments at his own expense on hollow spherical projectiles filled with bullets. By 1803 his shell was adopted for service. This destructive shell has now come into universal use. In 1808 the Duke of Wellington testified to its remarkable value and recommended that the invention should not be made public but that Shrapnel should be given a suitable reward as compensation for being deprived of fame and honour by such a secrecy. He further said, in regard to the praise that should go to Shrapnel, "You may say anything you please, you cannot say too much". Sir George Wood who commanded the artillery brigade at Waterloo wrote in 1815 that had it not been for Shrapnel's shells, the battle of Waterloo could not have been won.

The Board of Ordnance did not, however, uphold the request of Shrapnel to be compensated for the expenditure he had incurred in the invention. In 1837 when Shrapnel was the guest of William IV, the king personally acknowledged his high sense of his services and was agreeable to confer a baronetcy on him. But the death of Shrapnel's son shortly thereafter led to the dropping of the proposal. Shrapnel himself died a disappointed man, at Southampton 13 March, 1842.

Courten, William (1642-1702)

WILLIAM COURTEN, a British naturalist, was born in London 28 March, 1642. While in his travels to Montpelier, he came across Sloane and this led to his interest in botany. After a good deal of foreign travel, he opened in 1684 his botanical museum in the Temple. It was estimated to cost 50,000 guineas. This went over to Sloane and ultimately became the nucleus of the famous Sloane collection of the British Museum.

Courten's name was immortalised by Robert Brown who founded the genus *Courtenia* upon a plant from Java.

Courten died at Kensington 29 March, 1702.

S. R. RANGANATHAN
University Library,
Madras.

SCIENCE NOTES AND NEWS

Solar Influences on Terrestrial Conditions.—The studies made at the Solar Physics Observatory, Kodaikanal, of the periodic phenomena connected with solar activity, such as, the number and dimensions of spots, prominences, bright and dark markings, show that the present solar cycle, which began in 1933, reached its maximum intensity in 1937, and remained at the maximum all through 1938. At the moment, the activity is on the down grade and may be expected to reach its minimum in 1943–44.

Some of the short-lived, sporadic phenomena studied are the eruptions which present a variety of appearances and effects. For example, on June 2, 1937, a very massive prominence with a base of 1,67,000 miles and a height of 85,000 miles, which had been stable for more than three days, was suddenly blown up presumably by an eruption. On several occasions eruptions on the sun were found to cause radio "fade-outs" and general dislocation of radio communications. Particularly, when vigorous eruptions in the neighbourhood of sunspots close to the central meridian were observed, magnetic and electric disturbances invariably occurred on the earth. A remarkable instance of such solar influences on terrestrial conditions was the great magnetic storm and auroral display of March 24, 1940, when a great eruption affected several hundred million square miles of the sun's visible surface.

Forest Research in India and Burma during 1940–41.—The first part of this annual publication (Manager of Publications, Delhi, Rs. 1-12) recently issued, records the work turned out during the year at the Forest Research Institute, Dehra Dun. It was inevitable that war supply problems should preponderate in the research programme for the year. The authorities responsible for the policy of the Institute decided that research should be the main preoccupation even during the war. During times of stress, it is not easy to resist the temptation of converting such institutions to mere supply units. The wisdom of the authorities in taking this major decision of policy could be seen in practically every page of the present publication wherein practical solutions of many problems ranging from army hutments to tent pegs, are intermingled with the results of "pure" research in "sylviculture" whose contribution to the development of Indian forest research would be substantial even in the post-war period.

This report of 161 pages consists of seven chapters; the first one gives very readable summaries of the several branches of the Institute, prefaced by a "General" summary. The following six chapters give more detailed accounts of the work in the sylvicultural, utilisation, entomology, chemistry and timber development branches. Not the least important amongst the contributions of the Forest Research Institute to the war effort is the provision of trained personnel for jobs requiring specialised training. During the year, 48 publications emanated from the Institute in addition to 26 papers in scientific journals. The total expenditure of the Institute was about 6½ lakhs of rupees.

Root-Inducing Substances.—The root-inducing activities of indole acetic acid, naphthalene acetic acid, phenylacetic acid and their esters have attracted the attention of both scientists and nurserymen, and large-scale experiments have been carried out to utilise these substances for clonal propagation of economic plants. The growth substances induce root formation when they are used in dilute solutions, and the effective concentration can only be determined by a series of tests. Lanolin, water and talc powder can be made use of as carriers.

In a recent work Hitchcock and Zimmerman (*Contr. Boyce Thompson Inst.*, 1940, 11, 143) have shown the root-inducing properties of these substances when they are used in mixtures. A higher percentage of rooted cuttings and uniform rooting was manifested in cases of application with mixtures. Vitamin B_1 and ethylene functioned as activators for root formation when they were applied in combination with the growth substances. M. J. T.

Pupation of *Ephestia kuehniella* Zell.—Old prepupa, a high percentage of younger prepupæ, and a few old larvæ of *E. kuehniella*, can pupate at 6–9° C. (42·8–48·2°). The young prepupæ and old larvæ that are unable to pupate at this low temperature, develop into "permanent larvæ", living considerably longer than their pupating age-mates, without pupating. Larvæ kept for 2–8 months in this temperature are able to pupate if returned to room temperature. If, however, their heads, the source of the pupation harmone, are tied off, they become permanent larvæ, surviving as long as 2–3 months in the larval state. It is concluded that the formation of the pupation harmone is inhibited by exposure to low temperatures and there is some indication that the tissues can, perhaps, react to a harmone stimulus at low temperature (Caspari, *J. Expt. Zool.*, 1941, 86).

The Indian Lac Cess Committee.—The annual report for the year ending 31st March 1941, records the activities of the Indian Lac Research Institute in India, the London Shellac Research Bureau and the Special Officer, Lac Inquiry and Co-operative Research.

A refreshing feature of the Committee's work is the co-operative research started in this country and in England. The Committee has made grants to Messrs. The Metropolitan-Vickers

Electrical Company, Ltd., and the India Moulding Company, Calcutta. We are also told that steps have already been taken to carry out co-operative research work on rubber-shellac combinations in India.

Special mention should be made of the exceedingly practical step taken by the Committee in sanctioning a sum of Rs. 2,000 for practical aid to be given in 1941-42 to manufacturers of lac in trying out experimentally improvements effected at the Indian Lac Research Institute in methods of manufacture and utilisation of lac. It is hoped that this praiseworthy step will soon result in the stabilisation and expansion of the old industries and in the creation of new ones.

Charcoal for Lorries and Buses.—An important leaflet relating to the production of charcoal, suitable for producer gas for lorries and buses, has recently been issued by the Forest Research Institute. Owing to the urgent need for conserving petrol, attention has centred on the possibility of converting a large number of lorries and buses into charcoal-gas vehicles. There are now some 37,000 such vehicles in British India and assuming that half of these are to be converted to run on charcoal gas, approximately 18,000 tons of charcoal per month will be required. India can produce suitable charcoal for the purpose; what is needed is organization especially in the spheres of supply, grading and distribution.

Any hard, close-textured wood makes good charcoal. The harder and closer-textured the wood is, the better the charcoal for producer gas, provided its ash content is low. *A few* of the suitable woods listed in the leaflet are:—Babul (*Acacia arabica*), axle-wood (*Anogeissus latifolia*), casuarina, anjan (*Hardwickia binata*) and the oaks (*Quercus* spp.). The charcoals produced from these woods have been tried on producer gas plants and found suitable. Leaflet No. 9 (published by the Forest Research Institute, Dehra Dun) gives specifications for producer-gas charcoal, and other information likely to be of use to charcoal manufacturers.

Locust Situation in Northern India.—In spite of the cold weather, locust swarms in the fortnight ending on December 20, 1941, were active in the western United Provinces, southern and western Punjab and eastern districts of Baluchistan. There was very little swarm activity in the permanent breeding areas, *viz.*, Rajputana, desert parts of Sind and coastal areas of Baluchistan. In the Punjab and the U.P., the conditions are ominous as they generally receive rain during spring when due to rise in temperature the over-wintering locusts are expected to breed if soil-moisture conditions become suitable.

American Technical Mission for India.—The announcement that an American Technical Mission is to visit India is of considerable interest. Until the summer of 1941 when the effect of the Lease-Lend legislation in the United States began to be felt in India, contacts between India and the United States had remained more or less normal. America was buying mica, manganese, and other raw materials from India, while India was buying from America motor vehicle chassis, machine tools, and other things required for the war effort, as well as a large range of ordinary merchandise the flow of which was naturally restricted by the dollar exchange position.

With the establishment of the Indian Purchasing Mission in the United States, the position has changed. India has had to state very fully her case for

and after a study of the documents presented to them by Sir Shanmukham Chetty the American experts suggested that India might benefit considerably by the visit of a Technical Mission from America. This suggestion has been welcomed by the Government of India, the more so in that they are well aware that in America, as in the other Allied countries, experts are very fully occupied at the present time with war production. It is hoped that the Mission may be able to fill some of the gaps in India's munitions production.

The Government of the United Kingdom have been actively concerned with the development of India's resources for the supply of war requirements by implementing the recommendations of the Chatfield and Roger Mission reports and otherwise. They have expressed their appreciation of the initiative of the Government of the United States of America and their confidence that it will lead to valuable results in supplementing what has already been done.

Indian Central Jute Committee.—According to a press note dated 4th March 1942 issued by the Publicity Officer, the Indian Central Jute Committee, in furtherance of its policy of associating the Universities in research work on jute, has sanctioned a grant of Rs. 16,580 for 1942–43 to be distributed as follows:—

University of Calcutta:—Schemes for X-Ray Research on jute fibres by Prof. M. N. Saha—Rs. 5,060; Investigation on the chemical utilisation of jute and jute waste by Dr. B. C. Guha—Rs. 2,800; Bio-chemical investigations of the processes involved in the retting of jute by Dr. B. C. Guha—Rs. 2,300.

University of Dacca:—Scheme for impregnation of bleached fibre with suitable resins by Dr. J. K. Chowdhury—Rs. 3,300.

Presidency College:—Researches relating to the growth and development of jute fibre by Prof. B. C. Kundu—Rs. 3,120.

The total approximate financial liability of the Committee in connection with these schemes, spread over three years, is expected to be Rs. 46,980.

Research Scholarships and Fellowships in the University of Patna.—With a view to stimulate and intensify research, the University of Patna have provided Rs. 15,000 for the year 1941. In consideration of the present conditions, the Syndicate have felt the need of giving special encouragement for the prosecution of research in the pure and applied sciences. Under the new scheme which was drawn

by a Special Committee appointed for the purpose, the value of the research scholarships has been raised to Rs. 100 per month, ordinarily open to graduates of the Patna University. The University have also instituted Research Fellowships of the value of Rs. 150 per month, open to candidates who have secured the degree of PH.D., or M.D., or M.S., of the Patna University on the basis of their researches. These candidates are expected to devote the whole of their time to research and are not permitted to undertake any other kind of work.

The Syndicate has also come to the conclusion that "Research Scholarships may be awarded to suitable candidates of the University to work at institutions outside Patna, *e.g.*, Jamshedpur Research Institute, Indian Institute of Science at Bangalore, etc., and other similar places, where graduates of the Patna University may be admitted to work under eminent and distinguished scientists. The Vice-Chancellor has also been advised that the problems of research chosen should be of immediate value to the areas under the jurisdiction of the Patna University. It would be appreciated, that research in such subjects as mining, mineralogy and geology, are of supreme importance. But, as no scheme is ready whereby admission of Patna University graduates is assured to institutions where such researches can be carried on, the Syndicate has felt that for the time being, it is precluded from awarding scholarships for research at any such places. As soon, however, as such a scheme is worked out, it is proposed to award scholarship for research in those subjects."

Scientific and Industrial Research Board, Hyderabad.—The Second Meeting of the Board was held under the presidentship of the Hon. Nawab Sir Aqeel Jung Bahadur, on 27th December 1941, to consider the programme of researches recommended by the various research committees under the Board and to allocate funds. The Chairman of each committee explained the schemes of research proposed by his committee after which there was a full discussion regarding the relative importance and utility of different problems. A total grant of Rs. 21,500 for a period of one year was sanctioned by the Board for carrying out research work on certain problems recommended by the research committees. The grant was distributed among the various committees as follows:—

Vegetable Oil Utilization Committee—Rs. 2,500; Pharmaceutical and Drugs Committee—Rs. 4,000; Fuel Committee—Rs. 500; Fibre Research Committee—Rs. 2,000; Ceramic Research Committee—Rs. 4,000; Heavy Chemicals Committee—Rs. 5,000; Forest Products Utilization Committee—Rs. 1,000; Industrial Ferments Committee—Rs. 2,500.

Medical Degrees which are not Recognised in India.—The Medical Council of India have recommended to the Government of India that the recognition of medical degrees granted by certain Universities in Australia, South Africa, Ceylon, Canada, Hongcong and Malaya should be discontinued as these countries recognise Indian medical qualifications only when the qualifications are recognised by the General Medical Council in the United Kingdom. The Government of India have accepted the recommendation.

The withdrawal of recognition will affect only degrees to be granted after March 31, 1942.

The Medical Council is prepared to enter into negotiations for the mutual recognition of medical qualifications with countries which are willing to recognise Indian qualifications on the basis of direct reciprocity.

The Universities concerned are:—The University of Sydney. The University of Adelaide, The University of Capetown, The University of Witwaterstand. Johannesburg, the Ceylon Medical College, Nova Scotia Provincial Medical Board, Dalhousie University, The University of Hongkong, and the King Edward VII College of Medicine, Singapore.

Dr. N. Kesava Panikkar, M.A. (Hons.), D.Sc., Empire Overseas Research Scholar of the Royal Commission for the Exhibition of 1851, has been appointed Professor of Zoology in H. H. The Maharaja's College of Science, Trivandrum. Dr. Panikkar is a distinguished graduate of the Madras University and a member of the staff of the Madras Christian College. He was awarded the Exhibition Scholarship in 1938 for research in Marine Biology. While in England, Dr. Panikkar was engaged in the study of the mechanism of physiological adaptation in animals. He has some 26 papers to his credit.

Information has been received that the Royal Society has provided a special grant for his researches at Travancore.

Calcutta University.—Dr. Bidhan Chandra Roy has been appointed Vice-Chancellor of the Calcutta University for a period of 2 years in succession to the Hon'ble Sir Azizul Haque who has been appointed High Commissioner for India in London.

Andhra University.—At the meeting of the Senate held on the 14th March, Sir C. R. Reddy was unanimously re-elected Vice-Chancellor of the University for a further period of three years. The election was uncontested. Sir C. R. Reddy possesses the unprecedented record of having been elected Vice-Chancellor for five terms.

SEISMOLOGICAL NOTES

During the month of February 1942, one moderate and two slight earthquake shocks were recorded by the Colaba seismographs as against three moderate, and six slight ones recorded during the same month in 1941. Details for February 1942, are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
February 1942		H.	M.	(Miles)		(Miles)	
16	Slight	23	39	5870	..	..	
21	Moderate	12	38	4230	..	..	
22	Slight	03	17	13[illegible]0	Lat. 27° N., Long. 92° E., in Assam	..	Reported to have been felt in parts of Bengal and Assam

MAGNETIC NOTES

February 1942, was magnetically more disturbed than the previous month. There were 12 *quiet* days, 12 days of *slight* disturbance and 4 of *moderate* disturbance during February 1942, as against 5 quiet days, 22 days of slight disturbance and one of moderate disturbance during February of last year. The day of largest disturbance during February 1942 was the 23rd and the quietest day was the 18th.

The characters of individual days were as follows:

Quiet days	Disturbed days	
	Slight	Moderate
3, 4, 7-9, 11-13, 17, 18, 21, 26.	1, 2, 10, 14-16, 19, 20, 22, 24, 25, 27.	5, 6, 23, 28.

No magnetic storms were recorded during the month of February this year as also last year. The mean character figure of the month is 0·71 as against 0·86 for February of last year.

M. R. RANGASWAMI.

ASTRONOMICAL NOTES

Planets during April 1942.—Venus will be a conspicuously bright object visible in the eastern elongation from the Sun (46° 19′). Mercury: On April 14, the planet reaches greatest western elongation from the Sun (46° 19′). Mercury likewise will be a morning star in the first half of April, but will be too close to the Sun to be well seen during the month; it is in superior conjunction on April 20 and passes afterwards into the evening sky. The four major planets Mars, Jupiter, Saturn and Uranus continue to be near each other in the constellation Taurus and can still be seen in the western sky for a short while after sunset. In their eastward motion among the stars Mars will overtake Jupiter on April 4 when there will be a close conjunction of the two planets. Similarly Saturn overtakes Uranus on April 28 and as the objects will be fairly close to each other at the time (Saturn about a degree and a half to the south of Uranus) it will not be difficult to locate the latter planet with some slight optical aid.

T. P. B.

ANNOUNCEMENTS

The Indian Geographical Association.—At the annual meeting of the Madras Geographical Association held at Madras on March 7, a resolution to the effect that the name of the Association should be changed to the Indian Geographical Association was adopted. The *Journal of the Madras Geographical Association* will henceforth be called the *Indian Geographical Journal.* The headquarters of the Association will continue to be at Madras and provision has been made for starting local branches all over India.

A Fresh Cycle of Desert Locust in India (*Curr. Sci.*, 1941, 10, 479).—We have been informed that the map illustrating the article has been adapted with modifications from Uvarov (*Imp. Bur. Ent.*, London, 1928, pp. 252–55). We regret that this was not mentioned in the article.

* * *

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 90, Nos. 4601–4603.

"Journal of Agricultural Research," Vol. 63, Nos. 7-8 and. 11.

"Biochemical Journal," Vol. 35, Nos. 8-9.

"Contributions from Boyce Thompson Institute," Vol. 12, No. 3.

"Journal of Chemical Physics," Vol. 9, Nos. 11 and 12.

"Journal of the Indian Chemical Society," Vol. 18, No. 11.

"Chemical Products," Vol. 5, Nos. 1-2.

"Indian Forester," Vol. 68, No. 3.

"Transactions of the Faraday Society," Vol. 37, Part 12.

"Indian Farming," Vol. 3, No. 2.

"Indian Central Jute Committee (Bulletin)," Vol. 4, No. 11.

"Review of Applied Mycology," Vol. 20, Pts. 1 and 2.

"Journal of Nutrition," Vol. 22, Nos. 5 and 6.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences: (*Proceedings*)

February 1942. SECTION A.—SIR C. V. RAMAN: *New concepts of the solid state.* Presidential address to the Indian Academy of Sciences, 1941. R. P. SHINTRE: *Studies in educational statistics. Part IV. A criterion of examination efficiency by the method of adjusted plot yields.* K. NEELAKANTAM AND L. RAMACHANDRA ROW: *Fluorescence reactions with boric acid and o-hydroxy-carbonyl compounds, and their application in analytical chemistry.* VIKRAM SARABHAI: *The time distribution of cosmic rays.* At least upto the small time intervals 1/50 sec. reached in the experiment, the arrivals of cosmic rays follow a law to be expected from time randomness; and their behaviour is therefore similar to that shown by radiations from radioactive sources. H. J. BHABHA AND D. BASU: *The theory of particles in spin half and the Compton effect.* The formula for the scattering of radiation by a free electron on the hole theory is calculated. The hole theory is in definite disagreement with experiments on scattering although it is in at least qualitative agreement with nature in describing the existence of the position and the process of pair creation, and is the only form in which the Dirac theory is logically tenable. L. RAMACHANDRA ROW AND T. R. SESHADRI: *Flavylium salts containing pyrone rings.* P. SURYAPRAKASA RAO: *Occurrence of luteolin in the flowers of* Chrysanthemum indicum. S. S. PILLAI: *On numbers of the form* $2^a \cdot 3^b$ *(I).* S. S. PILLAI AND ALLEYAMMA GEORGE: *On numbers of the form* $2^a \cdot 3^b$ *(II).* T. K. KRISHNASWAMY: *Estimation of cystine by nitroprusside.* The method described has the advantage of simplicity over the Sullivan reaction, and is more specific than the Folin and Marenzi uric acid reagent.

SECTION B.—SIR C. V. RAMAN: *New concepts of the solid state.* T. S. RAGHAVAN AND V. K. SRINIVASAN: *A contribution to the life-history of* Vahlia viscosa, *Roxb., and* Vahlia oldenlandioides, *Roxb.* N. K. IYENGAR: *Trypsin-kinase in blood.* N. K. IYENGAR: *Anti-tryptic components of blood.* N. K. IYENGAR: *Prothrombin and plasma trypsin.*

Indian Chemical Society: (*Journal*)

November 1941.—N. N. GODBOLE, B. G. GUNDE AND P. D. SRIVASTAVA: *The seed fat of* Buchanania latifolia. T. L. RAMA CHAR: *Studies on the photochemical activity of mixtures of vanadic acid and tartaric acid. Part II. Photocatalysis by colloidal micelle obtained by the reduction of vanadic and tartaric acid. Induced optical activity by circularly polarised light.* PRODOSH CHANDRA RAYCHOUDHURY: *Normal aluminium chromate.* PRODOSH CHANDRA RAYCHOUDHURY: *Periodates of tervalent metals.* R. P. DAROGA: *The colorimetric* (p-*dimethyl-aminobenzaldehyde-sulphuric acid*) *method for determining small quantities of atropine.* P. L. KAPUR AND BADAR-UD-DIN: *Estimation of copper in presence of iron.* R. K. BAHL, SURJIT SINGH AND NARINDRA K. BALI: *Estimation of iodine in periodates.* S. SIDDIQUI AND Z. AHMAD: *A note on the new formula for chaksine.* D. P. CHATTERJEE: *A note on the separation of silicon and tin in tin-silica mixture welding brasses and silicon brasses by alkali sulphate.*

Tin and Its Uses:

October 1941, No. 11.—"The current issue of *Tin and Its Uses,* the Quarterly Review of the Tin Research Institute, examines the various trends in tin consumption in the United States in the present emergency. The relative merits of tin and the suggested alternatives are discussed, and it is concluded that major changes in the use of tin would involve substantial expenditure on research and new equipment, and are likely to be deferred so long as the supply position permits. American stocks and deliveries of tin are particularly favourable at present, and if the analogy of British experience is followed, war production will still further stimulate, rather than diminish, the consumption of tin.

"Progress in the Institute's programme of industrial research is reported in this issue. The causes of difficulty in tinning certain batches of mild steel are explained, and various simple means of rectification are described. It is emphasised that there need be no steels difficult to tin provided that suitable precautions are taken in manufacture, and that buyers should be able to avoid troubles by specifying steel of "good tinning quality".

"The Institute has carried out tests on alternatives for palm oil and tallow in the hot-tinning process. Certain oils have been compounded which have excellent stability at high temperatures and considerable freedom from fuming and from fire hazard. Trials of these oils in industrial plants have been highly successful.

"Other articles in this issue include a description of an Australian test of the Institute's process for protecting tinplate against sulphur-staining by foodstuffs; a review of the use of tin in printing metals; an account of further improvements in tinfoil; and a pictorial record of special uses of canned foods in war-time England."

ERRATUM

Vol. 11, No. 2, February 1942, Page 81, in the table pertaining to Magnetic Notes: Under Quiet days, figure 18 has been omitted, and under moderate days for 2 *read* 17.

SUPPLEMENT TO CURRENT SCIENCE

Vol. XI] MARCH 1942 [No. 3

HEREDITY AND ENVIRONMENT IN HUMAN GENETICS*

BY

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HUMAN genetics has become a field in which the principles of genetics and cytology determined by experiments with plants and animals can be applied to an ever-increasing extent. We speak of animal and plant breeding as applied genetics, but the need of applying genetical principles to the reproduction of mankind is even more urgent than is the case with domesticated plants and animals. With the latter, selection of the best individuals as parents of the next generation is continually practised, and defective individuals are rigidly excluded from reproduction. Man has hitherto failed seriously, however, in applying to his own species the rules which he finds so necessary for the improvement or even the maintenance of his flocks and herds and his plant crops.

Any student of human genetics knows that large numbers of the same aberrations and abnormalities, both physical and mental (nervous), occur in mankind and in the higher mammals. These deleterious parallel mutations are carefully weeded out from the animals over which we have control, and among wild animals natural selection weeds them out. One of the outstanding discoveries of modern genetics is that all organisms produce such mutations, the majority of them deleterious in their effects and some of them even lethal. That they flourish in our own species is well attested by innumerable published pedigrees of almost every conceivable abnormality of body and mind—pedigrees extending often to five or six and sometimes even to ten or more generations in a single family. How is it possible to think of the improvement of civilized man while these weeds grow unchecked in the human garden? It is a little-considered fact that the matings of this generation determine in their entire hereditary make-up the qualities of all future generations.

Selective mating is a well-known fact, that is, that like tends to mate with like. This applies not only to stature (in some cases), but also to the blind, the deaf and the congenitally maimed. They tend to marry each other and so perpetuate the condition if it is due to inheritance, as it is in a large proportion of cases. At the other end of the scale, it is clear that various types of ability are inherited. Mathematical and musical ability are outstanding cases, but there are many others. Any student of genetics knows that if a defect such as feeble-mindedness is inherited, its normal counterpart is also inherited. A few psychologists still quaver at the acceptance of mental inheritance, but anyone who faces the facts squarely will be obliged to admit that, however you analyze the mind, mental differences are inherited as well as their physical basis in the brain and the central nervous system. A few examples of such inheritance will be referred to later.

But heredity does not work in a vacuum. Heredity and environment are like the two sides of a shield, the shield being the developing organism. An optimum environment is just as essential, but no more so, than a good heredity, if a satisfactory result is to be achieved. Nature has taken infinite pains to ensure that the early environment of the developing embryo will be uniform and that it will have complete protection. What it becomes will then depend largely on the genetic composition of the two germ cells that united to begin its development. Incredibly small differences are found to be inherited through a whole series of generations. Most of the differences we see in any gathering of people are determined mainly by heredity. A very unfavourable environment may inhibit the developmental potentialities of the

* A lecture given at Vassar College, Nov. 12, 1941.

organism, making the individual stunted and starved either in body or mind, and by an unsuitable environment he may be warped or distorted in his mental and physical processes. But the inheritance carried in his or her germ cells will not be changed by such treatment. Cases are on record of identical twins, developed from a single egg cell and having the same heredity, one of whom developed scoliasis (curvature of the spine). This induced condition would obviously not be inherited.

Heredity and environment have played their part in producing the various races of mankind as we know them. But the active part in the differentiation of races has no doubt been played by inherited (germinal) variations or mutations. The beginnings of racial differentiation are lost in paleontological obscurity and it is impossible to draw any sharp distinction between the so-called racial differences among modern men and specific differences such as that between Neanderthal man (*Homo neanderthalensis*) and *Homo sapiens*. The conventional habit of applying the latter specific name to all living races of mankind is probably not justified. This view, which I first expressed some years ago, is strengthened by the recent discovery that three different species of Cebus monkey are inter-fertile and will interbreed. Many anthropologists believe that Neanderthal man interbred with Cromagnon man (who supplanted him in Europe) and is therefore a part of our direct ancestry. At any rate, the criterion of intersterility as a mark of species (either present or past) as distinguished from races, no longer exists.

When we consider the main types of living man from a genetical point of view, some of the racial characters appear to be adaptive in nature while others probably have no adaptive value. Since it has been found that the nasal index (length : breadth) of peoples from Terra del Fuego to the Arctic coast of Canada correspond roughly with the degrees of North or South latitude in which they live, it appears that the very narrow nasal passages of the Eskimo are an adaptation to breathing cold air while the broad, flaring nostrils of the African negro are advantageous for breathing the warm, moist air of the tropics. The thick lips and dark, glandular skin of the negro are probably also adaptations to the high temperature and intense sunlight of the tropics. On the other hand, the kinky hair, which is equally characteristic of the negro type, is probably not adaptive. The straight hair of the American Indian or the wavy hair of the Australian aborigine would do as well in a tropical environment. That this racial character of kinky hair has arisen as a single mutation appears to be indicated by the fact that it has appeared independently as a rare mutation inherited through several generations in families in Norway, England and Holland. The kinky or woolly condition is dominant in inheritance in these families, just as the kinky hair of the negro is dominant in crosses with other races.

It is now recognized that not only physical but physiological differences exist between the human races. We have already referred to adaptations of the negro to the tropics and the Eskimo to Arctic conditions. Negroes are also believed to be immune to the virus of yellow fever, although hypersusceptible to the bacillus of tuberculosis. Japanese similarly appear to be immune to scarlet fever and the Chinese relatively immune to the tetanus bacillus. Measles is a mild virus disease among Caucasians but very severe for North American Indians and Melanesians. Malaysians are more susceptible to beri-beri (lack of vitamin B_1) than other races. Some of these resistances have probably been gradually acquired by the selection resulting from exposure of successive generations to the disease organism over a long period. In other cases the racial resistance appears to be more of the nature of a happy chance. Experimental studies of resistance and susceptibility to many parasitic diseases in plants and animals lead to similar points of view. These differences persist even with different races living under essentially the same conditions. Thus in New York City, statistics show that Russians, Poles and Jews are much more resistant to tuberculosis than are the Irish.

These inherited differences in resistance to particular diseases apply not only to races but also to the individuals within a race. Thus some 50% of human beings and 30% of horses show natural immunity to diphtheria. Similarly, experiments showed that in Berlin in 1907 nearly 100% of the house mice were susceptible to tumour inoculation. The same was true of about 24% of the mice in Hamburg while

practically none of the mice in Oslo were susceptible. There are similar great variations in the susceptibility of pigs and rabbits to enteritis. Many cattle are immune to *Bacillus abortus* and over 50% of rats are immune to plague. Many of these resistances are probably Mendelian in their inheritance. Such cases of inherited resistance to particular micro-organisms could be largely multiplied from the experimental literature. They emphasize the importance of the inherited constitution of the individual, whereas medical attention has too frequently been concentrated entirely on the attacking bacillus.

Statistics show also that resistance varies at different stages of development. For instance, the mortality rate from diphtheria and scarlatina is at first higher for males and later becomes higher for females. It has been shown that constitutional factors also play an important part in the structure of the teeth, the intestines and the eye. The fact that the mortality rates for various diseases differ in males and females again shows the effect of genetic constitution.

From time to time epidemics of infantile paralysis (poliomyelitis) occur, the origins of which cannot be traced. In a study of this condition in 222 families in which a case of infantile paralysis had occurred, 35% of the other children had minor illnesses at about the same time, whereas in families without infantile paralysis only 9% of the children were ill. A part at least of this higher incidence of illness was due to an abortive form of infantile paralysis lasting from a few hours of indisposition to several days of illness. Nasal washings from such cases when inoculated into monkeys actually produced the typical symptoms of poliomyelitis. It is therefore clear that many children are highly resistant to the disease. They may be temporary carriers of the virus and yet have only minor symptoms. Quite possibly others who harbour the virus for a longer period without symptoms may be the infective source of the epidemic.

Other studies have shown that constitution of the child is more important than the virus in the development of poliomyelitis. From an anthropometric study of susceptible children it is found that the susceptible type is large and plump, with a broad, round face and frequently widespaced dentition. Those in whom the disease was most severe and often fatal were a more delicate, brunette type with high colouring of lips and cheeks and crowded teeth. The fathers and mothers also showed certain characteristic features. Anthropometric data from 57 male and 52 female affected children showed that the interpupillary distance was great, the hands short and broad, the pelvis wide in comparison to the shoulders. There were also certain mongoloid tendencies, suggesting thyroid deficiency. While the matter requires further investigation, it seems clear that susceptible children are distinguishable by a whole series of constitutional differences from other children.

Racial differences, however, are not confined to differences in susceptibility to attack by micro-organisms. Organic diseases which are a direct inheritance vary markedly in their incidence from race to race. Thus amaurotic idiocy is a metabolic and mental derangement, genetically determined and lethal in its effect, which appears to be largely or wholly confined to Jews. In Italy there is a disease, known as favism, caused by eating the broad bean (*Vicia faba*) or inhaling the pollen of this plant. In Sardinia there are thousands of cases every year. It also occurs in Greece and North Africa and occasionally in people of Mediterranean ancestry living in the United States. But it appears to be confined to peoples of the Mediterranean race and not to occur in more Northern countries where the broad bean is also commonly eaten. This is an allergic disease affecting the red blood cells, and it was recognized as early as the 5th century B.C.

Sicklemia is a non-pathological condition of the red blood corpuscles in which they are sickle-shaped, with long, spine-like ends. It is inherited as a simple Mendelian dominant. In a small proportion of cases the affected red cells are attacked and destroyed by cells of the spleen, causing anæmia. This condition is accompanied by atrophy of the spleen and disappearance of the malpighian corpuscles. Some 7% of negroes have these sickle-shaped cells in their blood. The condition was formerly believed to be confined to negroes but has also been found in people of Greek and Italian descent. So it may prove to be characteristic of the Mediterranean as well as the negro race. The medical literature

also contains reports of several white families in which many of the red corpuscles were elliptical or oval in shape. This condition is inherited and is not accompanied by any ill effects, so it is only discovered when the blood is examined for some other purpose. Its frequency in the population is unknown, but it is probably rare, because many people now have their blood examined in hospitals. This is an example of the many slight abnormalities which are inherited but do not reduce the efficiency of the organism to any appreciable extent.

Levit has developed a large Medico-Genetical Institute in Moscow, where human genetics was being studied by a medical and genetical staff on a larger scale than in any other country. The fact that Russian families are large is also an aid in such investigations. More than 800 pairs of twins were studied medically to obtain as full an understanding as possible of their genetical (constitutional) make-up and development. Formulæ have been developed for the more accurate determination of the parts played by heredity and environment in the various stages of ontogeny. In this country, Newman and others have made extensive studies of twins, including pairs of identical twins (monozygotic, derived from the fertilization of a single egg cell) reared apart from an early age. These cases, which are almost as satisfactory material as an actual experiment, show that the remarkable physical resemblance of identical twins persists, even when they are reared under quite different social and climatic conditions. Even the finger print patterns are remarkably similar and only the minutiæ of these patterns, which make every human being unique, are beyond the limits of hereditary determination. Corresponding with these on the mental side are the differences which appear in the personalities and intelligence of the twins reared under different conditions of life. It appears, as might be expected, that the city dweller has an acquired urbanity which the twin brought up in the country does not possess. Certain emotional differences also appear. As regards intelligence, while the I.Q., as measured by the ordinary tests, is somewhat higher in the twin with the better education, yet the difference produced in this way is generally not large.

The detailed study and comparison of twins thus remains one of the most useful methods for investigating the relative effects of nature and nurture. Levit and his colleagues have shown in this way the important role of heredity in connection with the time of teething, sitting up and walking and in connection with such features as susceptibility to scarlet fever in children. Weight at birth was found to be practically unconnected with the genetic composition of the child. By comparison of children and adults, the effect of heredity on blood pressure and pulse rate was found to be very strong. As regards the sinus system and its conformation, various parts were found to differ greatly in hereditary determination. In a Jewish family in Western Germany a pedigree of very acute sinus trouble has been studied. The condition was inherited as a simple Mendelian dominant character, 17 cases occurring in a pedigree of three generations. By the use of the electrocardiogram for identical twins, Levit discovered a relation between the size of the heart and the "T"-wave on the electrocardiogram which is obscured by other factors in the general population. Thus even the detailed relation of physiological activities to morphological factors can be discovered. Identical twins were also treated differently and the results compared. Thus when one member of rachitic twins was treated with ultra-violet rays his immediate improvement was clear, but some months later the untreated twin was found to be superior in general health and resistance to disease.

From these and many other results, Levit emphasizes the fact that the roles of heredity and environment do not form a constant ratio in the growing organism, not even in relation to any one trait. These roles vary with age from infancy to senility. They vary also with the genetic and especially the environmental conditions. The extensive twin study results are classified according to the age of the twins and also according to their living conditions and the result is a more intimate analysis of environmental effects in some respects than has previously been attempted. Thus the most refined techniques of medicine, biology and statistics are being applied to a detailed and very practical solution of the nature-nurture problem. Such studies serve to emphasize that the human body is an almost infinitely complex moving equilibrium of organ systems from birth to death.

There is another aspect of the nature-nurture problem which is of great interest to anthropologists and psychologists. In a book which is soon to appear,* will be published an account of two native jungle children rescued from a wolf's den in India some years ago. They ate raw meat, drank like wolves, ran on all-fours, were active at night and had no language. Over a period of several years the diary records their reactions after they were brought to an orphanage. The elder girl survived several years and learned, after continual massaging, to stand and walk erect,—a matter at first of the greatest difficulty. She finally acquired many of the habits of civilization, such as the wearing of clothing, and gradually learned to speak, picking up a vocabulary of 30 or 40 words. Such records show how many of our civilized habits and customs are of the nature of conditioned reflexes, learned in babyhood from contact with our parents. The brain of these wolf children had not been permanently impaired, but its human development was inhibited by these early contacts with animals. A new set of reflexes and reactions had to be learned, including that of speech in place of the wolf's howl.

Blindness is a condition which of course may arise from an accident. But a large proportion of the cases of blindness are due to inheritance, even including many in which the condition is not congenital. Recent statistics show that in the United States the proportion of blind persons who have blind relatives or blind parents is, in the aggregate, 33·3%, while the proportion of blind individuals with blind brothers and sisters is 71·2%. Dr. Loeb, in an earlier study, found that in 1,204 families in which hereditary blindness is recorded there were 4,155 children, of whom 2,523 (60·8%) were born blind. More recent estimates conclude that 10-15% or more of all blindness is due to heredity, the frequency of blindness being about 1 in 1,000 in this country. This frequency estimate is evidently too low, however, since in 1932 there were 14,400 blind children in the United States under 20 years of age. 50,000 others were partially blind and some of them would develop total blindness later. Waardenburg lists more than 120 types of hereditary ocular variation, many of which cause blindness. Among the latter is glaucoma, and there are many pedigree of its inheritance in the literature. Sometimes it appears early and sometimes only in old age. The condition is one of hydrostatic tension within the eyeball, resulting from closure of the canal of schlemm, which may take place from various causes, hereditary or otherwise; or the intra-ocular tension may be set up by rigidity of the scleral coat or by effects on certain nerves or vasomotor centres. In certain families it is associated with gout, and various authors find that dark eyes are more predisposed to glaucoma than light eyes. These are probably matters of genetic linkage between otherwise unrelated conditions.

In a well-known family in Virginia, 18 cases of glaucoma developed in five generations. The original male ancestor married twice. The descendants by his first wife developed a high frequency of glaucoma, while those descended from the second wife were all free from this condition and included some of the leading men in American history. This type of glaucoma appears in the second or third decade and rapidly leads to blindness.

Deafness is another widespread condition which is often of hereditary origin. When only one ear is affected the deafness is likely to be of exogenous origin. The two main types of hereditary deafness are (1) deaf-mutism, in which the individual is congenitably without hearing and therefore unable to learn speech; and (2) otosclerosis, which usually comes on gradually in middle age, due to ankylosis of the stapes bone in the middle ear. Otosclerosis is inherited as a simple Mendelian recessive character. This means that two normal parents, if they both carry this gene, will have children one in four of whom may be expected to develop deafness in middle-age. The evidence indicates that hereditary deaf-mutism is produced by two genes, one of which controls the development of the ectodermal part of the cochlea, while the other controls the auditory nerve and its ganglion. Probably the development of the middle and outer ear is controlled by an independent pair of factors.

An exceedingly rare cause of deafness is the development of bilateral tumors on the auditory nerve. This produces a gradual onset of deafness and an unsteady gait. As

* Gesell Arnold, *Wolf Child and Human Child.* (Harper Brothers), 1941.

the tumors grow the optic nerve may also be affected, ultimately causing blindness. In an extensive pedigree with many affected individuals the inheritance is dominant. It also shows what is called "anticipation", *i.e.*, the age of onset in the second generation was 72 years, while in the three succeeding generations the average ages of onset were respectively 64, 41 and 28 years.

Statistics show that when the deaf marry the deaf, one-third of these unions produce deaf children. There is no present way of distinguishing the hereditary from acquired forms of deafness, except that evidence of inheritance may be obtained from the ancestry. Unilateral deafness is practically always due to extraneous causes. Snyder and his associates in Ohio studied 31 families in which both parents were deaf. Their children numbered 89, of whom 63 (70·8%) were deaf. The only danger from cousin marriages lies in the possibility that both may have inherited the gene for the same recessive abnormality. Deafness is such a serious handicap that it seems clear that persons afflicted with hereditary deafness should not have children. The tendency for the deaf to intermarry is so strong that Alexander Graham Bell in 1884 wrote a memoir "Upon the formation of a deaf variety of the human race", directing attention to this danger.

Microphthalmia is an inherited condition in which the eyeball is so small that the individual has weak eyesight or may be blind. In one unique pedigree this condition is inherited as a recessive sex-linked character, *i.e.*, it appears only in males but is transmitted by all their (normal) daughters. This is because the gene is in the X-chromosome and follows the zigzag course of that chromosome from male to female and from female to male in successive generations. Females, having also a normal X, do not develop the condition but transmit it to half their sons. In this pedigree of six generations, the microphthalmia is associated with mental deficiency in some individuals, while others are above average intelligence. As this association is also found in other pedigrees, these two conditions are probably both produced by a single gene, the microphthalmia itself being a very variable condition, like the end-results of an infective process in the eye. Fraser Roberts suggests that, since all those in this pedigree who are free from blindness are also free from mental defect, the mental defect must arise through extraneous influences at a critical stage in embryonic development which for genetic reasons, is abnormally sensitive.

Another condition which illustrates the pleiotropic or multiple effects of a single gene is known as acrocephalosyntactyly. Mohr describes such a family from a remote section of Norway. The father and five of the nine children showed the same conditions—syndactyly (webbing of certain fingers), a somewhat egg-shaped head with bulging forehead and underdeveloped occipital region, and intelligence somewhat below that of normal members of the family. In the inherited condition known as oxycephaly only the skull changes are present, without the associated abnormalities in the fingers.

Many families have been recorded in which the bones are so fragile that they are broken many times during infancy and childhood. In one such family the affected members are of short stature but have very long arms and legs. This is inherited as a dominant condition. In other families the condition of fragile bones is accompanied by blue sclerotics (due to the thinness or translucency of the white coating of the eyeball). A third condition associated with these two is otosclerosis. These three abnormalities, although one affects the bones, another the eye and a third the ear, are so commonly associated that they are probably all the effects of one gene. In those families where the effects on the eye or ear are suppressed this is probably due to some other feature present in the genetic constitution, or to the presence of modifying genes.

There are other pedigrees of anomalies which indicate that three or four genes are closely linked in the same chromosome. For example, anonychia (absence or defect of finger nails) may be closely associated with defect or absence of the patella and with luxation of the head of the radius. All three may be found together in certain pedigrees, in others the radius will be normal, while in still other families only the radius will be affected. These defects are very rare and are probably due to three separate genes which are so close together in a chromosome that they rarely or never cross-over, while the first two are in such intimate contact that they perhaps mutate

together. A fourth gene, for crooked little finger (camptodactyly), is associated with these three in some families. It is probably in the same chromosome but less closely linked.

A more complicated case is that of the Lawrence-Moon-Biedl syndrome, in which the cardinal symptoms are mental retardation, obesity, hypogenitalism, degeneration of the retina and polydactyly. After careful examination, no casual lesions are found either in the brain or the endocrine glands. These conditions have been regarded as the pleiotropic effects of a single recessive gene; but the pedigrees show that there is a preponderance of affected males and that the number of affected offspring is in excess of one-fourth in affected families. Dr. Madge Macklin has offered an explanation from a study of all the cases in the medical literature. She concludes that two factors are necessary for the production of this syndrome: (1) a dominant autosomal gene, (2) a recessive sex-linked gene.

Where the complicated effects of a gene involve more than one organ system it has sometimes been suggested that one germ layer, such as the ectoderm or the messoderm, has been involved. From a study of the creeper fowl, which shows many abnormalities from a single gene in the heterozygous condition which is lethal in the homozygous condition, Landauer concludes that the gene influences embryonic differentiation by producing a general retardation of growth. Thereby is determined a syndrome. Individual variations in the time and rate at which different embryonic organs appear will lead to frequent dissociation of the characters in the syndrome, but the gene will produce its effects by changes in the developmental pattern of the whole embryo. This type of explanation probably applies to many genes producing the more monstrous effects.

Another feature of the study of human heredity is that the same condition may be produced in one case by purely extraneous causes and in another by inheritance. The only way to distinguish them is by a study of the ancestors and collateral relations. Thus rickets is well known as a condition of children produced by lack of sunlight and vitamin D. But in certain cases where there has been no diet deficiency the same symptoms seem to have resulted from osseous dystrophy which was genetically determined. Hollow chest, also known as cobbler's breast, has long been supposed to be a result of the cobbler bending over his last. But it has recently been shown that this depression of the sternum is inherited in certain families as a simple dominant, and it is questionable whether it is an occupational disease at all.

To take an example of another kind, it is generally supposed that ingrowing toenails are the result of wearing tight shoes. I have no doubt that they are produced in this way sometimes, yet it is clear that the tendency to grow in will be greater if the nails show a strong lateral curvature. If the conditions were due solely to tight shoes, we might expect it to be more frequent in women than men, yet it is actually more frequent in men. In a recent case (*Lancet*, 1941, II: 410), a soldier who had been wearing army boots for 2½ years became ill and spent 14 months in hospital. During this time, in the absence of shoes, he developed an ingrowing nail which required attention. His nails were found to show an exceptional degree of lateral curvature. So even an ingrowing toenail has its inheritance element, which is by no means easy to disentangle from environmental effect.

Even the same symptoms may be due to different genetic causes. Thus hæmophilia is a condition in which the blood fails to clot, so that a slight wound causes a long period of bleeding. This is well known to be inherited as a sex-linked character. A rare condition has been described in a Russian family which shows the same symptoms of extreme abnormal bleeding, but this is caused by weakness of the capillary walls, the blood itself being normal, and it is not sex-linked in inheritance.

It seems that in many cases the genetic basis of an inherited peculiarity is quite different from what at first appears. Thus encysted tumors of the scalp are inherited, but the cause of their formation is probably an abnormally narrow duct to the sebaceous glands. Some of the inherited mental deficiencies have a biochemical basis. One form of oligophrenia (mental defect) is the result of failure to oxidize phenylpyruvic acid. It is inherited as a simple recessive condition. Albinism is biochemically related to this condition. Amaurotic idiocy (Tay-Sachs's disease) results from failure to oxidize the lipoid sphyngomyelin. Thus it is clear that even our mental condition has a biochemical basis.

Another peculiar inherited condition of

the nervous system probably has a biochemical basis. Several families are known in which excitement, a carbohydrate meal, cold or other causes will produce a temporary and more or less complete paralysis of the nervous system without loss of consciousness. The individual is helpless and speechless for a short time. Over 150 such cases have been reported from many parts of the world, and it is shown to be inherited in several families. It is known as temporary paralysis. The condition may come on periodically or under stress and it can be produced by excessive doses of desoxycorticosterone in the treatment of Addison's disease.

This condition is remarkably similar to that found in a breed of goats in Tennessee and Texas. When frightened, these goats become rigid so they can be pushed over and lie motionless for a short time before they recover. I have likened this condition to the death-feigning instinct in insects. It probably represents an essentially parallel mutation in these three groups of the animal kingdom. Somewhat similar is a white Vienna strain of rabbits which is spontaneously epileptic. By an injection of cardiazol, an epileptic seizure can be produced in animals or in man. It appears that a smaller dose will produce a fit in an inherited epileptic than in a non-inherited epileptic or in a non-epileptic, and so the method may be of diagnostic value.

Premature whitening of the hair is well known to be inherited in families. The gene in this case may in some way produce a lack of para-amino-benzoic acid, for it has been found that graying hair may become darkened by taking small doses of this substance. The relation of insulin to diabetes is too well known to need discussion here. But it may be pointed out that if this important medical discovery and the use to which it is put results in more diabetics passing on their inherited defect to the next generation, then the last state, from a racial point of view, is worse than the first.

An important study was made in Holland of the relation between physical resemblance and mental similarity. The thick-set eurosomics were found to be quiet, level-headed, giving a thoughtful impression, with relatively low temperature, slow pulse-rate and slow respiration. Slender leptosomics were psychologically more irritable and emotional. They tend to speak, walk and write with some haste, agitation and uncertainty. Their temperature is high, pulse and respiration rapid. Numerous psychograms were collected from parents and children. It was found that children who have a greater physical resemblance to one parent will also show greater mental similarity to that parent. No doubt many parents have made general observations of this sort on their own children. From a study of nearly 1,000 parents and nearly 2,000 children, it was concluded that the similarity between parent and child in activity, emotionality and in primary and secondary functions was greater when they physically resemble each other than when they do not. They also show greater similarity in intellectual performance, memory, etc. Physical resemblance was accompanied by similarity of all mental functions. While it is difficult to distinguish heredity from the effects of education, it was concluded that heredity far exceeds education in character formation and that the inheritance of moral qualities is greater than that of intellectual ones.

Finally, in connection with the nature and nurture problem I might point out how intimately we are all affected by the weather, and still more by climate. In a recent study of disease localization in the U.S. it was shown that meteorological conditions produce stimulation, overstimulation, fatigue and death, with effects on every shade of organ-function and disfunction, in every physical, psychical, economic and social sphere. We live at the bottom of an ocean of air and the normal individual is constantly reacting to his meteorological environment by a chemical and endocrine rhythm. Changes in barometric pressure, temperature and humidity may help or aggravate headaches, epilepsy, asthma, arthritis, gastric ulcer, neuroses, glaucoma, focal infections, urticaria and other conditions.

When we study any one inherited condition we try to find its least common denominator, to separate the specific effect of a particular gene from the rest of the genetic make-up or constitution and from the disturbing effects of a varying environment. Heredity is the solid residuum which persists from generation to generation, no matter under what climate or conditions we live.

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OUR FOOD POSITION

THE HON'BLE MR. NALINI RANJAN SARKER, the Member in charge of the Department of Education, Health and Lands, Government of India, convened a Conference at New Delhi on Monday, the 6th April 1942, to consider ways and means for increasing food production in the country. Mr. Sarker told the Conference that the country was confronted with an unprecedented food situation, and that there was a shortage in our food supplies, and that the position might become more serious if internal transport difficulties were accentuated. He appealed to the Conference, which was attended by the representatives of the Provincial and State Governments, to make every endeavour to combat the shortage, and said that to the extent the deficit could be made up and regional self-sufficiency secured, the population will have food in full or in part.

The food production drive is primarily the responsibility of the Provincial and State Governments, but the warning given by Mr. Sarker is timely and the lead given is helpful. At the Conference, which was also attended by the Finance and Commerce Members of the Government of India, the exchange of views and information and the discussions on the several aspects of the problem emphasised the necessity for immediately launching a vigorous campaign for more food crop production. The Conference also recognised that an invitation to increase the production of food crops should also give an assurance to the cultivator to allay apprehensions in regard to loss that might arise in the event of fall in prices. Government have agreed, should such a contingency arise, to buy such food crops in the open market to prevent a serious deterioration in prices. This is an arrangement in which the interests of the cultivators, governments and the public coincide. The Conference convened by Mr. Sarker was thus a successful one,

and we may look forward to a countrywide effort for combating the threatened food shortage and for securing self-sufficiency not only for the country as a whole but also for the deficit regions.

Under normal conditions, India was importing annually fourteen lakhs of tons of rice from Burma and some wheat from Australia. These imports and the production of the country were enough to make India self-sufficient in respect of her normal requirements. The cessation of the supplies from outside, the reduction in the current year's harvests in the country, the growing demand for wheat and the possibility of internal transport difficulties becoming more acute, threaten a serious shortage in the food position of the country. The position in regard to the other food grains—millets, maize and gram—appears to be normal.

The average annual production of rice is 265 lakhs of tons. There is a decrease of nine lakhs of tons in the production during the current year. This and the deficit occasioned by the cessation of imports from Burma make a total shortage of twenty-three lakhs of tons in rice. The average production of wheat is one hundred lakhs of tons. The current harvest is estimated at ninety-nine lakhs of tons, and there is likely to be a deficit of one lakh of tons in wheat production. This is in so far as normal requirements go. Over and above these, the demands for military purposes and the supplies to Ceylon have to be met. These deficits have to be made good by increase in production not only in the deficit areas but also by securing a further increase in production in the self-sufficient and surplus regions of the country.

Mr. Sarker made it clear that if it should be found that the net shortage in all or any one of the major staple food grains cannot be made good, the next endeavour should be to supplement or substitute the commodity that is short by that which is surplus. If even that is not found possible, then it would be for the various Governments to consider an all-round cut in the consumption of food commodities, which, in effect, means rationing of food.

This is a timely and sound warning and all concerned should take due note of it. The war situation has brought to the forefront the need for rapid production of all the commodities necessary for the cause with which India is identified. Food is not the least of them. In fact, farming and food production constitute the first line of defence and offence. There is case not only for the prosecution of research but also, due to the urgency of the situation, for a quick mobility. The several departments of Governments will doubtless work quickly and in close co-operation. The public can also render valuable assistance in the all-important matter of food production by propaganda, advice and assistance to the cultivators. What is wanted is systematic and effective planning and programme to meet the situation. An immediate and a very considerable increase in production may not be within the means and control of the individual peasant farmer, but it is nevertheless within the nation's power to achieve.

The two ways to attain the desired objective are (1) extension in the area under cultivation in general or under a given crop and (2) enhancement of yield per acre. Either both or whichever one promises to

yield better results should be the direction in which greater effort should be made.

About eighteen per cent. of the area of the country, equivalent to nearly 92 million acres, is shown in agricultural statistics as being culturable waste other than fallow. How much of this land is suitable and will be immediately available for cultivation, is difficult to say. Having regard to the gradual increase in the arable area during the last fifty years much of the more easily tractable waste land has been brought under the plough, and that which remains, is either scattered or is the property of such administrations as Railways, Public Works Departments and Cantonments. In any case, much of this land is not likely to be of immediate use, but such land as runs parallel to railway lines and major irrigation canal banks, wherever permitted and wherever water facilities exist or rainfall allows, can be advantageously employed either for food grain cultivation or for growing fodder grasses and vegetable crops which will not require ploughing up the land which will erode and weaken canal banks or bunds.

The major influences which determine the cropping plan and the programme of the agriculturist are the monsoon and the ruling prices. Consequently, the area devoted to a crop fluctuates from year to year but the relative proportions of the areas are within limits and are approximately eighty per cent. under food crops and twenty per cent. under non-food crops. The proportion of the area under the major staple food crops represents the natural adaptability of crops as dictated essentially by climate, namely, monsoon (rainfall), temperature and growing seasons. Rice which occupies a dominant position thrives best in a warm humid climate and is therefore cultivated in areas of heavy monsoon rainfall or in areas where plentiful water supply exists. Wheat prefers the relatively cooler and drier climate of northern India where it can have a longer growing season than in the south. The important group of millets is found in arid and semi-arid regions where temperatures are ordinarily high and evaporation is greater than precipitation. The great characteristic of millets is their ability to withstand adverse conditions and if necessary to shorten their growing period without appreciable diminution in yields, unless moisture conditions are very drastically against them. This characteristic is to some extent seen in barley and possibly in wheat also. The natural adaptation of these crops is so specific that if the climatic factors and the concentrations of acreage are marked on the map of India, the demarcation of the regions is so clear as to justify calling them Rice India, Wheat India, and Millet India.

It would, therefore, appear that the possibility of substitution within the group of crops is not very much. A certain amount of land under short staple cotton and under oil-seed can and should be put under food grains particularly millets but as the determining factor is the monsoon and the distribution of rainfall, it is difficult to forecast the extent of such a substitution. Rice and wheat regions which are either largely situated in monsoon regions or enjoy good irrigation systems, offer greater promise of speedy improvement both in acreage and yield.

An increase in the acreages under rice and wheat over those of the current year,

may be effected by bringing back the areas which were once sown to these crops and which are not now under them. Comparing the maximum area under rice as reported in agricultural statistics in the past and the area during the season that has just past, it will be seen that the difference between the maximum attainable area and the area cropped last year is 25,80,000 acres. A similar figure for wheat is 17,61,000 acres. The figures are imposing and an examination by provinces, reveals the possibilities of such expansion principally in Assam, Bihar, Bombay, Orissa and the United Provinces. The possibilities of such return of land to wheat are indicated principally in the provinces of Bihar, Central Provinces, and the United Provinces. If propaganda and persuasion can bring back the areas that could previously be put under rice and wheat, an increase of over 9 lakhs of tons in rice on the basis of an average yield of 800 pounds to the acre, and an increase of 5 lakhs of tons of wheat on the basis of an average of 8 maunds of wheat per acre, can be expected.

Even during the last War, there was shortage of food. Only it appeared towards the end and the position then was not so serious as now. The situation was met by a vigorous campaign for manuring. If the food situation is more serious now, there is also more knowledge and experience available. The constructive research of agricultural investigators in different parts of India has provided the knowledge of the means of attaining the desired ends.

It is known that soils in many parts of India are in such a state as would generally respond profitably to an applicatin of fertilisers and manures. The use of high-yielding varieties of crops, the inadequate use of manures for various reasons and one-sided or unbalanced manuring, have brought about a state of agriculture which may, in short, be described as one of robbing the soil. What ordinarily happens is that the cultivator and his family consume the food crops that he grows and if and when there is a surplus it is sold. He gets more money value for crops like sugarcane, cotton, jute, tobacco, betel leaf, etc., than what he can obtain for his surplus food crops. The tendency, therefore, is to reserve the best portion of his land for money crops and also to manure them to the best of his means, and this more often than not happens even at the expense of food crops. The obvious result is that the original differences between the manured and unmanured land get emphasised year after year, leading to a further decrease in the productivity of the latter which also originally started with a disadvantage.

Again there is the result of the tendency to partial or unbalanced manurial treatment. It is an established fact that in the majority of cases much larger increases are almost invariably obtained with applications of nitrogen than either with phosphates singly or along with nitrogen. In order to cut down costs of manuring, phosphate applications are usually and naturally omitted even by those who understand the principles of manuring. The result is that in course of time increased cropping due to high-yielding varieties and the application of only nitrogenous manures, deplete phosphate supplies to the minimum and the inadequacy of phosphate then becomes a potent limiting factor for increase in crop production. There are on record several

long-period experiments in India to illustrate this fact.

Such being the general position, it is evident that suitable and adequate manuring offers the most promising line of attack on the problem. The application of this knowledge may not be within the reach of the individual cultivator or its application in any particular area may be fraught with difficulties due to lack of availability of seed or manure. Mere advice that the land should be manured, will be of no use. The cultivator knows that his lands respond to manuring and the Agricultural Departments can advise on manuring. What is wanted is the making of manures readily available to the cultivator at his place, in time for application to crops, and at a price which will be covered by the increase in yield.

This means an organisation not only for propaganda but also for making available on the spot to the cultivator, the manures that are required. The food situation created during the last War was met by initiating a campaign in which the officers of Agricultural Departments and students of Agricultural Colleges participated. The co-operation of manure manufacturing firms was enlisted. Oilcakes, fish, fish guano, bones, rock-phosphates were crushed and made into manure mixtures and quantities of the mixture were sent by rail to convenient centres and distributed from there to cultivators. The results were satisfactory.

The means to the desirable ends are known. What was possible twenty-five years ago should be possible now. What is wanted is immediate action in which Government departments and the public can co-operate. The season for rice is fast approaching. Quick mobility is necessary. The manurial resources available in the country should immediately be mobilised, and a programme of campaign should be drawn up and put into effect. It will not be undue optimism to expect an all-round average increase of thirty per cent. in food production as it happened in the past. The improvement to each individual cultivator will be appreciable. Even if it may not be very much it means in the aggregate a large increase in food supply. It may even mean a decent surplus.

B. VISWANATH.

INDIAN LOCUST DELEGATION TO IRAN

IT was recently pointed out (*Curr. Sci.*, 10, 479) that important sources of locust swarms which invaded North-West India last summer were from countries beyond the western frontiers of India, probably Iran, South-Eastern Arabia, etc., where the locust breeds during the spring season. Information was received in last February that there were heavy concentrations of the pest in Iranian Mekran. The situation being of potential danger to India during the next summer, the Government of India have sent a party of entomologists under the leadership of the Assistant Entomologist at the Imperial Agricultural Research Institute, New Delhi, to Iran to assist the Iranian authorities in the control of locusts in that country. The party left Quetta in March, and is expected to be at work in Iran for about 2 or 3 months.

DEPARTMENT OF METALLURGICAL RESEARCH AND RESEARCH WORKSHOP OF MECHANICAL ENGINEERING, AT THE INDIAN INSTITUTE OF SCIENCE

AT the fifth Annual Meeting of the Court, held on 28th March 1942, Sir M. Visvesvaraya, the President of the Court, invited the attention of the members to the recommendations of the Pope and Sewell Committees regarding the creation of a Mechanical Engineering Laboratory, considered indispensable for any scheme of expansion of the activities of the Institute and emphasised the fact that the need for such a research workshop, has been brought to the forefront by the exigencies of the war.

During the last few months the Institute has been confronted with the difficulty of meeting the demands of fine chemicals of the Supply Department of the Government of India, on account of the lack of modern equipment for handling unit processes on a semi-technical scale. The Institute has developed several processes and brought many pieces of industrial research to a successful stage; but the exploitation of these processes will almost exclusively depend upon the availability of the essential plant and machinery, which are extremely difficult to obtain at the present time.

Sir M. Visvesvaraya said, "The Institute does not possess the equipment or staff necessary to help big key industries. It is equipped to a certain extent for work in chemical industries but there are not sufficient facilities for dealing with research connected even with large-scale chemical industries. At a time of war like this, the organization of the Institute should be complete and ready to design any plant needed for large-scale chemical industries. A team of fuel engineers, chemical engineers, mechanical engineers and metallography experts, working in the closest collaboration, is necessary for solving new problems of design and construction in order that the manufacturing processes that are being evolved in the scientific and industrial laboratories in India may be exploited on a commercial scale. Adequate arrangements for giving instruction and carrying on research in metallurgy and applied mechanics have to be made soon if the Institute is to carry on industrial research effectively, and fulfil the high purpose which its Founder had in view."

In an editorial on "The Indian Chemical Industry", published in November 1939, we had occasion to plead for an immediate organisation of a Chemical Engineering Industry in the country. We wrote, "The designing and fabrication of chemical plant and machinery leading to the establishment of chemical engineering industries in the country, should be immediately taken up for serious consideration. The country possesses the necessary equipment and talent; we have large foundries and machine shops and skilled and capable workmanship is available. We may be lacking in some of specialised materials of construction like stainless steels and special alloys, but we could, for the moment, do without them. It is a matter of profound regret that the Central Government could not see their way to subsidise Sir M. Visvesvaraya's scheme for founding an automobile industry in this country, as this would have facilitated the establishment of the chemical engineering industries by providing the necessary background. The present opportunity should not be lost in laying the foundations of this industry on sound lines." Sir M. Visvesvaraya's plan is far more comprehensive and includes a department of metallurgical research which will provide the foundation for the production of a whole series of alloy steels and other non-ferrous materials of construction necessary for the fabrication of the modern chemical plant and machinery.

The recommendations of the Court with

regard to metallurgical research and research workshop, in general, have been accepted by the Council at their meeting held on the 30th March 1942 and the following resolutions have been adopted:

1. "That in view of the fact that metallurgical industries are rapidly developing in India, the Court is of opinion that the Department of Metallurgical Research should be established in the Indian Institute of Science at an early date.
2. "That in view of the fact that it is almost impossible to import from abroad ready made industrial plants for various manufacturing processes which are now being developed in India, it is desirable that a first class research workshop of mechanical engineering should be established in the Indian Institute of Science, Bangalore, with suitable staff attached to it, of fuel engineers, chemical engineers, mechanical engineers and metallography experts who by close co-operation and intimate team-work would be able to solve the problems of design and construction necessary for the erection of such plants."

The Council have appointed a Committee consisting of the following gentlemen to formulate proposals and recommend ways and means for implementing the above two resolutions: (1) Sir Vithal N. Chandavarkar, (2) Mr. M. Venkatanaranappa, and (3) The Director.

In the course of his Presidential Address Sir M. Visvesvaraya revealed that the Government of Mysore, who have taken a keen and abiding interest in the progress of the Institute, have shown their usual generosity by offering a capital grant of one lakh for a Department of Mechanical Engineering and a recurring grant of Rs. 15,000 for a Chair in Mechanical Engineering. He also pointed out the inadequacy of the grant from the Government of India, in view of the ever-increasing responsibilities which the Institute is being called upon to bear. He said "There are other long-range problems which escape attention because the Institute is still ill-equipped for dealing with them. One rarely notices discussions of new problems at our meetings. There is no dynamic spirit in their proceedings; the Institute has become static in its outlook. Some thirty years ago, the Government of India sanctioned a yearly grant of Rs. 1½ lakhs to this Institute. The growth of science in this interval has been revolutionary, and research work has acquired tremendous importance in the two Wars. But there has been no addition to the resources of the Institute. A further grant of Rs. 1½ to 2 lakhs from the Government of India has been long overdue." He also suggested the formation of an agency, through which public sympathy and support could be secured in the form of financial contributions and endowments from large-scale industrial establishments and public-spirited philanthropists.

The Committee, appointed by the Council, will go into this question and help to speed up the establishment of the two departments suggested by Sir M. Visvesvaraya. We are confident that the Government of India who have, in recent months, taken an active interest in the progress of Industrial Research in this country, will lend its moral and material support for the contemplated extension of the activities of the Institute.

PLANKTON STUDIES* IN THE FISHERIES BRANCH OF THE DEPARTMENT OF INDUSTRIES AND COMMERCE, MADRAS †

BY

D. W. DEVANESEN, M.A., Ph.D. (Lond.)

(*Krusadai Biological Station, Gulf of Manaar*)

THE outstanding results which the Marine Biological Station at West Hill (Malabar) has obtained from a knowledge of the coastal plankton of the Arabian Sea relate to

(1) the food of the Oil-sardine (*Sardinella longiceps*) and

(2) the food of the Mackerel (*Rastrelliger kanagurta*)

both of first-rate importance in the fisheries of Malabar.[1] Recent researches have revealed that both the Oil-sardine and the Mackerel regularly and normally feed on the fish-eggs occurring in the plankton. This is bound to have a far-reaching effect on the fluctuations of the fisheries of fishes on whose eggs the former may feed. This is receiving the attention of the West Hill Biological Station.

Recent studies have not only increased our knowledge of the food of the Oil-sardine and of the Mackerel but also have helped to ascertain the food of several other food-fishes feeding on planktonic organisms; *e.g.*, the food of the White Sardine (*Kowala thoracata*), another sardine of economic importance, the food of the Hilsa (*Hilsa ilisha*) during its sojourn in the sea, etc. Of the food of the anodromous Hilsa in the sea nothing was known hitherto. The stomach-contents of 80 specimens of Hilsa examined from 17-6-1941 to 20-11-1941 revealed a planktonic diet pure and simple. For instance, the lot examined on 7-8-1941 had the following:

Copepods, larval bivalves, dinoflagellates (*Ceratium masiliense, Ceratium breve* and *Peridinium depressum*) and phytoplankton (*Coscinidiscus gigas, Coscinodiscus lineatus and Chœtoceras coarctatum*).

This leads one to infer that the adult Hilsa cannot halt for a considerable period even in perennial rivers like the Ganges and the Indus which they seek for the purpose of spawning under sheltered conditions. Their pasture ground is the surface of the sea where planktonic organisms abound. When the spawning instinct seizes them, the Hilsa gather into shoals. To avoid the inevitable ravages of carnivorous fishes on such an occasion or wholly impelled by natural instinct, the Hilsa shoals escape into large rivers, there to spawn under sheltered conditions and return to the sea their natural feeding grounds and here to disintegrate and to deploy into smaller groups rendering the attack of their enemies less effective. This is an example where two factors are responsible for the migration of a fish-planktonic food at one end and spawning at the other extremity.

That Noctiluca, a phosphorescent planktonic organism competes with the Oil-sardine in feeding was observed in 1931. The former also feeds on such diatoms as *Coscinodiscus, Nitzchia* and *Fragillaria* which form the food of the Oil-sardine. Ribbons of the Flagillaria Colonies are wrapt equatorially round the body of Noctiluca and ingested—an effective method of having a sumptuous meal of a diatom. The abundance of the inedible Noctiluca may possibly have a bearing on a local scarcity of the Oil-sardine.

Noctiluca again is a round microscopical organism looking almost like a fish-egg. The plankton examined in September of last year at Quilandy, about 18 miles north of Calicut, at first appeared to contain nothing but Noctiluca. But a more careful examination showed that about 10 per cent. of the plankton was constituted by eggs of the Mackerel. The spawning Mackerels have probably exercised a choice in selecting an area where the inedible Noctiluca abounded for laying their eggs. Fishes feeding on fish-eggs would be loathe to enter an area

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* These studies relate to surface plankton only. Bathymetrical plankton studies have not yet been attempted.

† Published with the permission of the Joint Director of Industries and Commerce, Madras.

[1] *Vide* pp. 148–52 of Report 5 of 1923, *Madras Fisheries Bulletin*, **17.** "A Contribution to the Life-History of the Indian Sardine with Notes on the Plankton of Malabar Coast," by Hornell and Ramasamy.

where the inedible Noctiluca abounded. Thanks to the instinct of the Mackerel spawners, their eggs thus derive protection and have a better chance of hatching and being liberated as larvæ which could grow into young fish and increase the livestock of the Mackerel.

A most important line of investigation being pursued at the West Hill Biological Station is the study of live fish-eggs. This is expected to throw light on the spawning season of commercial fishes.

The part played by the tiny prawn-like phosphorescent Leucifer as a link in the food-chain of the sea is remarkable. The following fishes feed on Leucifer:

(1) The Oil-sardine (*Sardinella longiceps*).
(2) The Mackerel (*Rastrelliger kanagurta*).
(3) The Whitebait (*Stolephorus tri.*). One specimen, 60 mm. long, had in its stomach 257 specimens of Leucifer ranging in size from 7 to 12 mm. Leucifer is commonly found in another Whitebait as well, *viz.*, *Stolephorus commersonii.*
(4) In the Anchovies (*Engraulis spp.*) examined, Leucifer is occasionally found.
(5) In the large-scaled Hilsa (*Hilsa kanagurta*) also, Leucifer is occasionally met with.

As the result of studies made at the Marine Biological Station, Krusadai Island, Gulf of Manaar, the food of the following fishes was found to be planktonic.

(1) The Milk-fish (*Chanos chanos*).
(2) Sardines (*Pellona brachysoma, Anodontosoma chacunda, Dussumieria haseeltii* and *Sardinella gibbosa*).
(3) Silver-bellies (*Leiognathus brevirostris* and *Leiognathus insidiatrix*).

The alga *Trichodesmium* found in the plankton off Krusadai in great profusion during certain seasons forms a favourite item of diet of the Indian Sprat (*Sardinella gibbosa*), the Gizzard Shad (*Anodontosoma chacunda*), the Milk-fish (*Chanos chanos*) and of a Mullet (*Mugil waigiensis*). The fishery of these fishes depends to a certain extent on the abundant occurrence of the alga *Trichodesmium.* Arrow-worms (*Sagitta*) found ordinarily in plankton constitute an item of food again of the Indian Sprat and the Rainbow Sardine. Paucity or profusion, therefore, of Arrow-worms in the plankton would have a direct bearing on the scarcity or abundance of these fishes in the fishing areas.

A remarkable feature of the Krusadai phyto-plankton is the occurrence in great profusion of the Blue Green Algæ (*Oscillatoria irrigua*) and of *Bacillaria paradixa*[2] both known hitherto to occur in fresh-water. An equally remarkable feature of the West Hill phyto-plankton is the presence of a large percentage of dead diatoms. Apparently, dead diatoms do not sink at once.

A comparative study of the West-Hill phyto-plankton (Arabian Sea) and of the Krusadai phyto-plankton (Gulf of Manaar, Bay of Bengal) has brought to notice the great similarity between the two. Two species of *Biddulphia* (*B. mobiliensis* and *B. sinensis*), four species of *Chætoceras* (*C. coarctatus, C. debilis, C. affinis* and *C. lœvis*), four species again of *Rhizosolenia* (*R. alata, R. setigera, R. stollerforthii* and *R. styliformis*) and a number of other genera such as *Asterionella, Bacteriastrum, Coscinodiscus, Nitzschia, Pleurosigma, Thalassiothrix, Fragillaria,* etc., are found to occur in both areas. Are the hydrographical and other conditions necessary and suitable for planktonic life almost the same in both seas?

Both the Fisheries Biological Stations have contributed data on the planktonic diet of several fishes of commercial importance treated in the Bulletin "On the Common Food Fishes of Madras", which is now under preparation. Additional information can be obtained from the Departmental Administration Reports where plankton studies of both the Stations are annually reviewed.

[2] This is also found in brackish water.

INDIAN EUGENICS SOCIETY

WHAT is probably the first attempt to co-ordinate the efforts of a number of scientists to propagate the principles of Human genetics and Racial hygiene in India and to direct this for the betterment of the Indian population with a view to enhancing its surviving capacity in the struggle for existence, has been made in Bengal by a handful of scientific men who have started a society under the name of *Indian Eugenics Society*. How one wishes this attempt was made in a calmer atmosphere and when the human mind was free to think in terms of survival and betterment! Bitterness, racial animosity and strife are by no means congenial conditions for the growth of this sapling and one cannot but feel that this attempt is a very faint cry in a vast wilderness,—a cry that will be heard by a few.

Eugenics is definitely one aspect of scientific achievement that runs counter to war, and writing in the midst of war, one cannot help being overwhelmed by a sense of despair, of a feeling of fruitlessness, for, can not war, with one sweep, reduce the achievements of Eugenics into a confused rubble? Eugenics is probably the distilled essence of human scientific endeavour directed towards the betterment of mankind and it is impossible not to feel a sense of futility and helpless despair creeping up one's being.

The first bulletin published by the Society has reached us. It is a small, attractively printed pamphlet with a foreword by the President of the Society, Dr. B. K. Chatterjee, who gives a brief history of the origin of the Society and puts forth a plea for the co-operation of scientists and workers all over India for the cause.

The main article itself "The aims of objects of Eugenic researches in Bengal" is by the Secretary of the Society, Mr. S. S. Sarkar who has presented an admirable review of the Eugenic studies in that province. He has laid special emphasis on the marriage problem in the country and the need for sex education of the young. This latter problem is one which has been occupying of our educationists for a long time and one which they are consistently loth to face. World opinion is now almost unanimous on the need for sex education for the young but what form it must take is evidently dependent on the peculiar needs of the country and therefore must necessarily vary from one country to another. Before any attempt at Eugenic studies are made, this problem of sex education must be tackled and solved. In fact the Indian Eugenics Society itself could give the lead in this respect and could bend its energies towards a clarification of this vital issue. It is hoped that the second bulletin will endeavour to deal with this problem.

B. R. S.

AMERICAN TECHNICAL MISSION

WE wish to extend to the American Technical Mission, a hearty and cordial welcome to this country. The principal object of the Mission is to investigate the extent and scope of help which the Government of U.S.A. should render for extending and speeding up India's War effort.

The Mission is expected to remain in Delhi for more than a week and may visit two or three of the most important centres of production in India with a view to establish useful contacts with industrialists and officials in the country.

Dr. Henry Grady, Head of the Mission, is reported to have said that the foremost task of the Mission will be directed towards a consideration of those "missing links", whose prompt supply would bring about a more complete integration of India's war production machine. It is also intended to speed up and intensify the production of equipment, so that a more adequate proportion of India's great resources of manpower may be drawn into the armed forces.

"There are many American Technicians", he said, "who would be willing to come to India and not only help to train Indians but provide that industrial direction and drive which are peculiarly American."

OBITUARY

MR. NANGAPURAM VENKATESA IYENGAR, B.A.

WE regret to record the death of Mr. Nangapuram Venkatesa Iyengar, B.A., retired Meteorological Reporter to the Government of Mysore, on Wednesday, the 11th February 1942, at his residence in Malleswaram, Bangalore City.

Mr. N. Venkatesa Iyengar graduated from the Central College, Bangalore, in 1887 as the best student of his year in Physical Science in the Madras University, winning the Arni Gold Medal, and was the first in Mysore to secure this coveted prize. In the same year he was appointed as Assistant Master in the Central College, later on becoming Lecturer in Physiology in the F.A. classes and in Chemistry in the B.A. classes, and continued to teach these subjects till the end of 1894. He was then transferred to the newly-started Meteorological Department, of which he became the head in 1908 and continued to hold that office till he retired in 1922.

Mr. Venkatesa Iyengar was very much interested in the advancement of Kannada language and literature. He was an elected honorary Secretary of the *Karnataka Sahitya Parishat* for a number of years. He translated into elegant Kannada an English translation of Flammarion's *Astronomy for Women* and this was published by the *Parishat* from H. H. The Mysore Yuvaraja's Fund for the encouragement of scientific publications in Kannada.

During the Dewanship of Sir M. Visvesvaraya in Mysore, when a comprehensive plan for spreading modern scientific knowledge among the masses was launched in 1917, Mr. Venkatesa Iyengar helped to organise the publication of a popular scientific magazine in Kannada, known as *Vijnana,* almost the first of its kind to be published in any vernacular of India, and took up wholeheartedly the joint-editorship of that Journal. It is the country's great misfortune that soon after Sir M. Visvesvaraya laid down his office in 1918, this model of a scientific journal ceased publication. Mr. Venkatesa Iyengar also took a prominent part in arranging for a series of popular science lectures in Kannada under the auspices of the *Mysore Economic Conference* brought into existence by Sir M. Visvesvaraya. He was for sometime placed on special duty under the Inspector-General of Education to write science books for students.

Mr. Venkatesa Iyengar was a student of religion, philosophy and literature as well, and was an independent thinker. He was a great admirer of Sri Ramakrishna Paramahamsa and Swamy Vivekananda, whose works he read devoutedly and translated into Kannada what seemed to him the best in them, for the edification of his countrymen.

With regard to his personal qualities Mr. Venkatesa Iyengar possessed a good many virtues: He was straigtforward, thoroughly honest in word and deed, very scrupulous in keeping time and appointments, and intolerant of injustice in any form. He was a keen observer of men and things, was rather reserved and disliked personal advertisement. Though over seventy he looked much younger for his age and was very active.

He was 75 when he died. We are the poorer for the loss of such an exceptionally admirable person.

B. V.

LETTERS TO THE EDITOR

SYNTHESIS OF N[1]-SUBSTITUTED SULPHANILAMIDES

WITH the object of ascertaining the relative antibacterial merits of sulphanilamides derived, among a few others, chiefly from heterocyclic ring-systems, the N[1]-substituted derivatives listed in the table have been prepared.

No.	Name	M.P./°C.
1	4 Sulphanilamido acetophenone, *[a]	189–90
2	ω-Sulphanilamido acetophenone[a]	176–7 d.
3	ω-Sulphanilamido α-acetonaphthone[b]	169
4	N[4]-Acetyl sulphanilamido guanidine[a]	117–18
5	5-Sulphanilamido indazole[a]	243–44d.
6	7-Sulphanilamido indazole[a]	249–50 d
7	5-Sulphanilamido benzotriazole[a]	135–37
8	3, N[4]-Acetyl sulphanilamido 1:2:4 triazole[a]	204
9	3-Sulphanilamido indotriazine[c]	d. at 200–1

* Literature[1] gives the m.p. 208°; (*a*) colourless needles; (*b*) pale needles; (*c*) yellow needles.

The requisite starting amines were obtained by the methods reported in literature with few modifications; the only exception was 3-amino indotriazine, necessary for the preparation of the corresponding sulphanilamide (No. 9) which was synthesised by adopting the procedure of De and Dutta.[2] Isatin condensed with aminoguanidine carbonate in glacial HAc to give a good yield of 3-amino indotriazine: yellow needles, m.p. 195–6°d. The amino bodies were condensed severally with crystallised acetyl sulphanilyl chloride in pyridine medium and the resulting N[4]-acetyl derivatives subjected to the hydrolytic action of hot dil. HCl or NaOH. Except in the case of the N[4]-acetyl derivatives of guanidine (No. 4) and triazole (No. 8), where the attempts to isolate the final compounds were not met with success, hydrolysis to the respective sulphanilamides proceeded smoothly.

The compounds are being investigated as to their usefulness in experimental bacterial infections with particular reference to plague in mice at this Institute and the results will be communicated in due course.

S. RAJAGOPALAN.

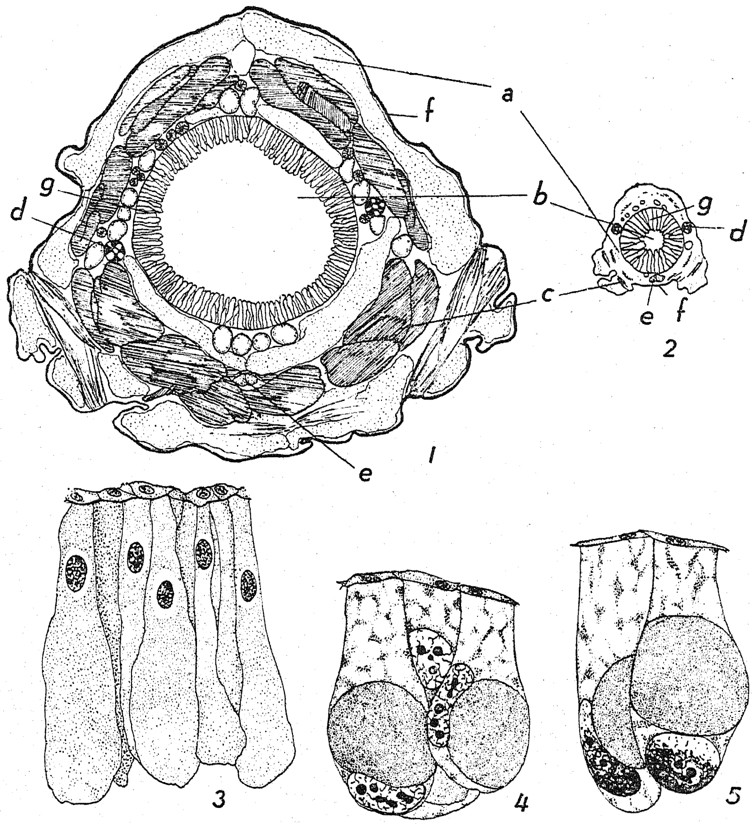
Haffkine Institute,
Bombay,
April 1, 1942.

1 E. Merck, Fr. 847, 244 (1939); C. A., 1941, **35**, 5513.
2 De and Dutta, *Ber.*, 1931, **64**, 2604.

STUDIES IN INSECT NUTRITION: SYMPTOMOLOGY OF AVITAMINOSIS IN *CORCYRA CEPHALONICA*, STAINT. —A HISTOLOGICAL STUDY

THE larvæ fed on a starch-yeast diet grow normally and complete their life cycle in the same period as when they are fed on cereals, their natural diet. These larvæ exhibit high sensitivity to the mildest of stimuli, *i.e.*, when their sensory hairs are gently tickled with a camel hair, the insects respond very quickly.

The larvæ, fed on a diet of starch and autoclaved yeast, in striking contrast to the other batch of the same age or size, remain undeveloped and exhibit extreme sluggishness. Their sensory hairs do not respond to the strongest of stimuli. It was of interest to determine if any of the well-known syndromes or histological lesions induced by avitaminosis, could be detected in any of the tissues of the insect. In the course of a discussion, Dr. V. Narasimhamurthy of the Public Health Department of the Government of Mysore, pointed out that insects in general and rice moth in particular, offers an exceptionally convenient material for such studies. The dimunitive size of the animal facilitates the fixation, embedding and sectioning and staining of the whole



1. Transverse section at the region of the midgut of a normally grown larva, 30 days old. × 100.
2. Transverse section at the region of the midgut of a larva fed on Vit B_1-free diet, 30 days old. × 100.
a—Adipose tissue; *b*—Cavity of the alimentary canal; *c*—Musculature; *d*—Silk-gland; *e*—Nerve cord; *f*—Cuticle; *g*—Cells of the coelomic epithelium.
3. A few cells of the coelomic epithelium of normally grown larva, 30 days old. × 1,200.
4. A few cells of the coelomic epithelium of a Vit B_1-deficient larva, 30 days old. × 1,200.
5. A few cells of the coelomic epithelium of Vit B_1-deficient larva, 60 days old. × 1,200.

organism intact, so that, the microscopic preparations portray all the organs of the body in one perspective and thus enable us to make a comparative study of the changes induced in the various tissues of the body.

The gross anatomy of the thirty-day-old larvæ (Fig. 1) consists of a waxy shining cuticle, underneath which exists a monocell thick epidermis. The dorsal half of the body has two layers of musculature while the ventral half is served by a single layer. The ventral nerve cord is double and the general nervous system is normally characteristic of the group insecta. Two tubular silk glands which run through the entire length of the body, are situated on either side of the gut and open at the anterior end of the larva. The entire cavity lying between the gut and the musculature and enclosed by the epidermis, is densely packed with adipose tissue.

The larva which is of the same age as that of the normal one but which is fed on a vitamin B_1-free diet (Fig. 2), exhibits a very poor development of the muscular system while the adipose tissue is either completely absent or when present, is traceable to only a few stray cells. Though some tissues show indications of very little growth beyond the stage of the tissues characteristic of a normally fed, five-day-old larva, there is a complete cessation of growth in the coelomic epithelium as revealed by Table I.

TABLE I

Description of the larva	Number of cells of the coelomic epithelium as seen in a transverse section of the midgut
1. Healthy, 30 days old	140
2. Healthy, 5 ,, ,,	30
3. B_1-deficient, 30 ,, ,,	30

An individual cell of the coelomic epithelium of a normal thirty-day-old larva (Fig. 3) shows its content of protoplasm homogeneous and turbid. The nucleus is disposed towards the upper end of the cell; the resting nucleus contains one or two nucleoli and the chromatin presents a granular appearance. A thin clear space can be discerned around the nucleus.

In a larva of the same age (30 days) fed on a B_1-free diet, marked differences are seen in the histology of the coelomic epithelium (Fig. 4). The protoplasm of the cell becomes highly vacuolate and presents a glandular structure at certain regions. A large globule of fat or lipoid (whose exact nature has not yet been determined) appears at random in the protoplasm and tends to increase in size. The clear empty space which was visible around the normal nucleus, disappears. The nucleus gets hypertrophied to a certain extent. It measures 12–16 μ across, whereas the corresponding nucleus in a normally grown larva of the same age measures 8–10 μ. The number of nucleoli increases by 4 to 6 in each nucleus by means of budding. The shape of the nucleus in many cases becomes distorted and is pushed towards a side of the cell due to the pressure exerted by the fat globule.

In still later stages of B_1-deficiency (60 days old) (Fig. 5) the nuclei of the coelomic epithelial cells, show acute stages of degeneracy. Its chromatin which stains heavily with hematoxylin becomes clumped up at a corner of the nuclear membrane; the stain is not wholly removed even after treating with strong destaining agents. It may also be recorded here that such nuclei do not answer the typical Feulgen reaction; a sort of dirty brownish colour is however given. The nuclei of a healthy larva on the other hand, stain a bright purplish violet, thus showing a physiological degeneration of the nuclei of the cells of the coelomic epithelium.

B. G. L. SWAMY.
M. SREENIVASAYA.

Indian Institute of Science,
Bangalore,
March 19, 1942.

VITAMIN B_1 IN INDIAN FOODSTUFFS (CEREALS, MILLETS AND PULSES)

THE vitamin B_1 content of Indian foodstuffs (cereals, millets and pulses) has been determined by the thiochrome method according to the quick and simple procedure developed by Murty and Rau[1] (Method I).

TABLE I

Variety and place of origin	Vitamin B_1 in γ per 100 gms.	
	Method I	Method II
1. Cereals :		
(*a*) *Oryza sativa*		
Co. 9 (Coimbatore)	480	485
Adt. 11 (,,)	360	..
Co. 4 (,,)	400	..
G.E.B. 24 (,,)	310	..
G.E.B. 24 (Mysore)	310	..
G.E.B. 24 (Berhampore)	250	..
Latisail, Amon (Bengal)	210	..
Kataktara, Aus (,,)	220	..
Boro, Jagli (,,)	445	435
Nakanda (Kangra)	210	..
Gurumati (C.P.)	260	..
16 B.K. (Bihar)	260	..
Coimbatore Sanna (Bangalore Market)	235	..
(*b*) *Triticum vulgare*		
——— (Bansi)	340	400
——— (Sarabathi)	420	500
———(Dharwar)	420	420
———(Samba)	250	280
2. Millets :		
(*a*) *Eleusine coracana*		335
H. 22 (Bangalore)	330	..
E.C. 593 (Coimbatore)	400	..
E.C. 2985 (,,)	300	..
E.C. 3517 (,,)	370	..
E.C. 3735 (,,)	270	280
E.C. 1540 (,,)	700	..
(*b*) *Sorghum vulgare*		
As. 29 (Coimbatore)	380	400
As. 2095 (,,)	490	..
3. Pulses*		
Cicer arietinum	380	470
Phaseolus mungo	185	510
Dolichos biflorous	70	520
Phaseolus radiatus	260	320
Dolichos lablab†	..	
Cajanus indicus	270	725

* Samples were purchased in Bangalore market.

† The acid extract of the field bean when made alkaline, taken up in isobutyl alcohol and irradiated showed brilliant fluorescence characteristic of thiochrome. Experiments are in progress to find out whether the field bean contains part of its Vitamin B_1 in the oxidised form.

The paddy samples were sun-dried, dehusked and powdered, while the other cereals, millets and pulses (with husk) were powdered and representative samples taken for vitamin B_1 estimation.

The vitamin B_1 content of at least one sample in each group of cereals, millets and pulses was estimated by Pyke's[2] method as modified by Booth[3] (Method II).

The results (average of at least three estimations in each set) are given in Table I.

It is clear from the results of Table I that all the cereals (excepting two varieties of wheat from Bansi and Sarabathi) and millets contain their vitamin B_1 in the free form, while the pulses contain it in combined form to different extents. Horse-gram (*Dolichos biflorous*) contains very little of vitamin B_1 in the free form while most of it exists in the combined form. *Cajanus indicus* contains the maximum namely 720 γ vitamin B_1 per 100 gm.

Another important observation made in the course of this investigation is that the per cent. recovery of added vitamin B_1 (Method I) is very high (70–90) with colourless acid extracts from rice and wheat, and low (50–60) with coloured acid extracts from ragi and pulses. This suggests that the inhibitors (substances which quench the fluorescence of thio-chrome) are associated more with colouring matter.

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March 31, 1942.

1 Murty and Rau, *Curr. Sci.*, 1941, **10**, 180.
2 Pyke, *J. Soc. Chem. Ind.*, 1939, **58**, 338.
3 Booth, *Ibid.*, 1940, **59**, 181.

YET MORE PARENTS FOR SUGARCANE BREEDING

It is now known that the genus *Saccharum* (Sugarcane) hybridises with other species and genera—some of them like *Narenga narenga, Sorghum durra* Stapf. and *Bambusa arundinacea* being taxonomically far removed from *Saccharum.* Cytological studies of such hybrids have revealed that on the mother or the *Saccharum* side the functioning gametes may be (1) reduced, (2) non-reduced or (3) both.[1] In cases where the non-reduced gametes function, the hybrids are fertile and in case of reduced gametes, the hybrids are often sterile, at least on the pollen side.

A cross between *Saccharum officinarum* (Vellai) and *Narenga narenga* was effected in the very early years of the Station, but no economic types resulted therefrom and as their flowers proved infertile, it was not possible to further hybridise them for economic results. Cytological studies of the hybrids showed that the divisions were irregular and that reduced gametes had functioned on the mother side. A cross between *Saccharum officinarum* (Vellai) ♀ and *Saccharum spontaneum* ♂ on the other hand yielded fertile hybrids and the gametes on the mother side were found to be non-reduced.

In the year 1941 a cross was effected between the hybrids (Vellai × *Narenga narenga*) ♀ and (Vellai × *Saccharum spontaneum*) ♂ and the resultant population of 32 plants included one which was pollen fertile. The parent *Narenga narenga* which could not previously be introduced into the line of parents for cane-breeding would thus appear to have now been brought into it by this roundabout hybridisation and useful developments are expected.

By a parallel process yet another parent, *Sclerostachya,* would also appear to have become available as parent in the future breeding work at Coimbatore. Satisfactory habit and marked tillering capacity are two of the useful characters in the two new parents thus sought to be introduced into sugarcane breeding.

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March 26, 1942.

1 Bremer, G., *Genetica*, 1923, **5**, 97, 273.
Janaki Ammal, E. K., *Jour. of Genetics*, 1941, **41**, 217.
Singh, T. S. N., *Ind. Jour. Agri. Sci.*, 1934, **6**, 1050.

TWO NEW REPORTS OF FUNGI ON *SACCHARUM OFFICINARUM* & *S. ARUNDINACEUM*

Schizophyllum commune Fries is a common saprophyte and it has been reported in India on the bark of dead trees from various localities (Butler and Bisby[1] and Mundkur.[2]). It has not been reported on the stalks of sugarcane though Butler[3] reported it as a doubtful parasite on cane when he recovered the fungus from five out of one hundred and sixty-one undergerminated setts in one of his experiments at Dehra Dun. Vincens[4] reported that the fungus was a weak parasite on sugarcane in Indo-China and that it was developing parasitic tendencies on various trees, *e.g.*, orange, mulberry, etc.

The characteristic fructifications of the fungus were found in November 1941 on a few dead cane stalks of Co. 331 which had been killed by 'red rot'. The excentrically borne pilei were downwardly directed, being sessile or with short stalks each individual stripis being rarely more than 0·6″ in length. The fructifications were borne in longitudinal rows over the internal lengths of the cane.

Similar fructifications of the fungus were observed a week later in Pusa on Co. 331 canes which were artificially infected with red rot through the inoculation of the mother setts and on red rotted Co. 331 canes brought from Motipur.

FIG. 1

Co. 331 with fructification of *Schizophyllum commune*

The three occurrences of *Schizophyllum commune* on Co. 331 suggested the possibility of weak parasitism on that variety and so inoculation tests were conducted by infecting growing stalks of Co. 331 with bits of the ripe fructifications and spore suspensions of the fungus. Five canes were bored at the bottom by means of a cork borer and the bits of fructifications introduced into the canes; into five more canes similarly bored spore suspension was introduced. After three weeks the canes were split open and the extent of infection noted on the basis of the length and width of infection and the number of internodes infected. The data averaged for each treatment are presented in Table I. *Schizophyllum commune* was recovered by culture from one of the canes in each treatment together with *Fusarium monoliforme* Sheld.

TABLE I

	Suspension	Bits of fructification
Average length of infection	6·2″	3·8″
Average number of infected internodes .. .	2·2	1
Average width of infection ..	0·42″	0·44″
Average volume of infection	1·2 C. in.	0·63 C. in.

From the data *Schizophyllum commune* appears to have only very weak parasitic tendencies on sugarcane. It probably invades cane tissues after their protoplasmic resistance is completely overpowered by a parasite. The observed occurrence of the fungus on Co. 331 alone, however, suggests a selectivity on the part of the fungus, the nature of which it may be possible to explain after some more studies on its physiology are carried out.

Darluca filum (Biv.) Cast. is a well-known parasite of the rusts and it has been reported in India on uredinea of *Puccinia polygonia amphibii* Butl. on *Polygonum* sp. from Mussoorie (Butler[5]) and on the cereal rusts *Puccinia purpurea* Cke., *P. penneseti* Zimmerm. and *P. setariœ italicœ* (Diet) Yoshino from South India (Ramakrishnan and Narasimhalu[6]).

During August 1940 rust caused by *Puccinia kuehnii* (Krueg.) Butl. was seen to develop abundantly on hitherto rust-free clumps of *Saccharum arundinaceum*. When sections of the rusted specimens were made, the uredosori of the fungus were found to be parasitised by *Darluca filum* (Fig. 2). Dark globular to ovoid

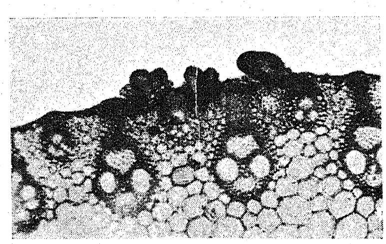

FIG. 2

Section of leaf of *Saccharum arundinaceum* with *D. filum* on *Puccinia kuehnii*

pycnidia were seen to arise, singly or in pairs from a majority of the uredosori. In the regions of the leaf where the parasite was absent, the uredosori were in dull orange coloured streaks along the length of the leaf but in the parasitised regions the sori were of a brown colour.

The pycnidia were dark in colour, ostiolate, and globular to ovoid in shape. In size they measured on an average $93 \cdot 5\,\mu \times 70 \cdot 5\,\mu$. The spores were hyaline, one septate and with a slight constriction in the region of the septum. The spores measured $15 \cdot 5\,\mu \times 5 \cdot 1\,\mu$ the range being $11 \cdot 3\,\mu - 18 \cdot 8\,\mu \times 3 \cdot 8\,\mu - 6 \cdot 3\,\mu$.

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Pusa, Bihar,
March 16, 1942.

[1] Butler, E. J., and Bisby, G. R., *Imp. Council Agr. Res., Sci. Monogr.*, No. 1, 1931, 128.

[2] Mundkur, B. B., *Ibid.*, No. 12, 1938, 28.

[3] Butler, E. J., *Mem. Dept. Agric., India, Bot. Series* 1, 1906, 39.

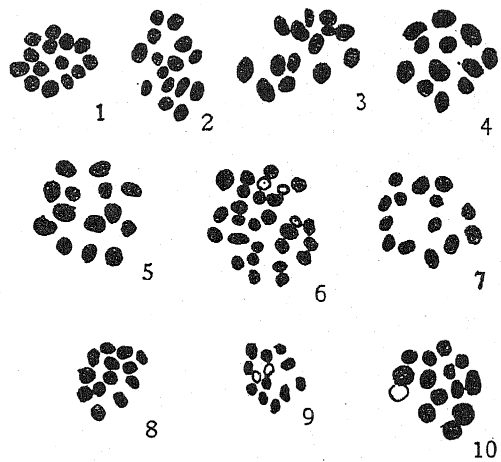
[4] Vincens, F., *Rev. App. Myc.*, 1921, 1, 41.

[5] Butler, E. J., *Mem. Dept. Agric., India, Bot. Series* 1, 1906, 154.

[6] Ramkrishnan, T. S., and Narasimhalu, I. L., "The Occurrence of *Darluca filum* (Biv.) Cast. on Cereal Rusts in South India," *Curr. Sci.*, 1941, **10**, 290.

CHROMOSOME NUMBERS OF SOME CÆSALPINIACEÆ

THIS note places on record the chromosome numbers of eight species belonging to four genera of the Cæsalpiniaceæ. These are *Bauhinia acuminata* Linn., *B. purpurea* Linn., *Parkinsonia aculeata* Linn., *Cæsalpinia bonducella* Flem., *Cassia glauca* Lamk., *C. glauca* Lamk. var. *suffruticosa* Koenig., *C. marginata* Roxb., *C. obtusifolia* Linn. and *C. siamea* Lamk. The work is of interest as chromosome numbers are known only for a very small number of plants belonging to this family. The chromosome numbers for all the species reported in the present note, except the last, have been determined for the first time. They have been determined in every case from meiotic divisions in the pollen-mother cells. The material for the investigation was collected from plants found wild or planted in various gardens at Benares. Nawaschin's fluid was used as the fixative and the sections were stained with Newton's Iodine Gentian Violet.



1. *Bauhinia acuminata*, I metaphase. 2. *B. acuminata*, II metaphase. 3. *Parkinsonia aculeata*, I metaphase. 4. *Cæsalpinia bonducella*, I metaphase. 5. *Cassia glauca*, I metaphase. 6. *C. glauca* var. *suffruticosa*, I metaphase. 7. *C. marginata*, II metaphase. 8. *C. obtusifolia*, I metaphase. 9. *C. obtusifolia*, II metaphase. 10. *C. siamea* I metaphase.

All figures are camera lucida drawings and have been reproduced at a magnification of 1600.

The haploid chromosome numbers for the various species investigated by the author are tabulated below:

Name of the species	Haploid chromosome number
Bauhinia acuminata Linn.	14
B. purpurea Linn.	14
Parkinsonia aculeata Linn.	14
Cæsalpinia bonducella Flem.	12
Cassia glauca Lamk.	14
C. glauca Lamk. var. *suffruticosa* Koenig.	28
C. marginata Roxb.	14
C. siamea Lamk.	14
C. obtusifolia Linn.	13

Jacob[1] has previously reported the diploid chromosome number for *Cassia siamea* from mitotic divisions in the root-tip cells as 28. The present observations therefore agree with his report.

The chromosome number for *Cassia glauca* is $14n$, for *C. glauca* var. *suffruticosa* $28n$. There is much difference morphologically between the two, whereby the latter variety merits to be raised to the status of a separate species. This opinion has been already expressed by Some taxonomists (Hooker).[2] The chromosome numbers of the two forms and their behaviour in meiotic divisions appear to support this opinion. A detailed discussion of the evidence will be presented in a later paper giving a full account of the writer's observations on the cytology of the Cæsalpiniaceæ.

The chromosome number of *Cassia obtusifolia* is $13n$. This species was included for a long time under *C. Tora* Linn. Prain[3] in 1900 pointed out the differences between the two. *C. obtusifolia* since then has been treated as a separate species in most Indian floras. Datta[4] and Senn[5] reported the chromosome number for *C. Tora* as $13n$, but Jacob[1] studying the root-tip cells counted 28 diploid chromosomes. He explains the difference between his observations and those of Datta and Senn by suggesting that the latter authors may have made a mistake in their counts due to occasional quadrivalent formation during meiosis. If this explanation is valid and the chromosome number $2n = 28$ for *C. Tora* is correct, the separation of *C. obtusifolia* from *C. Tora* can also be supported from cytological evidence. The chromosome counts in *C. obtusifolia* by the writer were made both from the I and II metaphase plates. There is therefore no possibility of a mistake being made due to quadrivalent formation.

The writer takes this opportunity to express his gratitude to Dr. A. C. Joshi of Benares Hindu University for his kind interest in the investigation and help in the preparation of this note. He is also indebted to Mr. J. Venkateswarlu of Andhra University for help in various ways.

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March 31, 1942.

1 Jacob, K. T., *Ann. Bot.*, *N.S.*, 1940, **4**, 201.
2 Hooker, J. D., *The Flora of British India.*, 1879, **2**.
3 Prain, D., *Jour. As. Soc. Beng.*, 1900, **46**, 159.
4 Datta, R. M., *Jour. Ind. Bot. Soc.*, 1933, **13**, 277.
5 Senn, H. A., *Bibliog. Genet.*, 1938, **12**, 175.

THE BLOOD GROUPS OF THE DOMS

THE unusually high percentage of Group B and AB found among the Bhatus and the Karwals, two criminal tribes of the United Provinces,[1] made me obtain further data from other criminal tribes as well. I do not think there exists any Blood Group data for the Doms, either from criminal tribes' settlements or from outside. Of the many groups of people tested by Malone and Lahiri, the Doms were not mentioned as one.

The Doms are scattered all over India. The U.P. Doms are divided into two branches, one settled, the other vagrant. Those who live in the cities or in their vicinity belong to the former section, while the nomadic Doms 'infest' the eastern districts of the U.P. and Bihar.

Blood Groups of more than 300 Doms were tested and the results are given below. About 185 samples were tested at Gorakhpur and 130 in the Dehra Dun district. The testing Sera were made at Lucknow by Dr. V. S. Manglik of K. G. Medical College from the author's blood which is BN and from that of a student donor, Mr. Murlidhar who is A. The Sera were standardised by testing against sera from the Central Research Institute, Kausali, and the Haffkine Institute, Bombay. While the tests were being done, a large incidence of B was noticed and to be sure of the result a number of people were pricked twice and examined, to test the accuracy of the result. The test

sera were examined every morning by titrating against Group AB and O blood cells. There was no difficulty in getting people to be pricked in the criminal tribe settlement at Gorakhpur but the Hill Dom samples could only be collected with very great difficulty, for, at least 20 villages had to be visited for 130 bloods. The table below shows the percentage of blood groups in the samples examined.

TABLE I

	Nos. and Percentages in Groups				
	0	A	B	AB	
180 (N) ..	59	41	71	9	Samples from Gorakhpur
Percentages ..	32·8	22·8	39·4	5·0	

The sample contained 99 males and 81 females and the following table gives the percentage distribution of Blood Groups according to sex.

TABLE II

Gorakhpur samples	Percentages in Groups and Frequencies of Genes							
	No.	0	A	B	AB	p	q	r
Males .. .	99	29·9	25·2	38·3	7·0	17·5	25·8	54·7
Females ..	81	37·0	20·0	40·5	2·5	11·9	25·8	60·8
Total Males and Females ..	180	32·8	22·8	39·4	5·0	15·1	25·6	57·3

The Doms of the Dehra Dun district, United Provinces, show the following group percentages.

TABLE III

Names of localities	Percentages in Groups and Frequencies of Genes							
	No.	0	A	B	AB	p	q	r
Jaunsar Bawar Dehradun, Kalsi and other places	125	36·0	20·0	33·8	10·2	16·4	25·1	60·0

A comparison of the Hill Dom data with those of the 'criminal' Doms of Gorakhpur show some apparently significant differences. The Hill Doms possess higher O than the 'criminal' Doms, though the women among the latter show a slightly higher O concentration, 37 p.c. against 36 p.c. of the former. Both the 'criminal' Doms male and female groups show a high percentage of B, the males 38·3 p.c., females 40·7 p.c. but the corresponding B among the Hill Doms is only 33·8 p.c. If B and AB, both are taken into consideration, the difference between the two Dom groups disappears. This high B among the criminal tribes may indicate 'inbreeding' condition, or a rapid B mutation rate or mixture with a people with high B concentration. As in the case of the Bhatus and the Karwals, two other criminal tribes we have examined, the criminal Doms show a high B incidence which distinguishes them from the Doms of other areas, particularly the Hill Doms and also from the normal population in the neighbourhood. Till we get further data from the many other criminal tribes in these Provinces, we need not interpret the anthropological significance of these serological findings.

One interesting fact was discovered in the Blood Group tests among the criminal Doms of Gorakhpur where whole families were examined in some cases. A large number of children, whom from the physical features, we could not affiliate to their parents, were tested against their parents' blood. Serological tests confirmed our suspicions in the case of five out of nine where the parents-children combination of blood groups were against the known mechanism of inheritance.

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March 5, 1942.

[1] *Science and Culture*, 1942, vii, No.7.

REVIEWS

A History of Tropical Medicine. By H. Harold Scott. (Edward Arnold & Co., London), 1939. Royal 8vo. Pp. xiv + 1119 with 13 plates. Two volumes. Price 50*sh.*

A History of Tropical Medicine by H. H. Scott, is one of those monumental works which every medical college library and some of the private libraries ought to possess. When Dr. Scott, with his unparallelled facilities and wide knowledge, takes the responsibility to write a book on this subject, the medical public and also the general reading public naturally expect the work to be both comprehensive and authoritative. Even if all these considerations failed to raise great expectations, the mention of the additional fact that the book is based on Fitz-Patrick lectures delivered before the Royal College of Physicians, London, in 1937–38, lends it the seal and dignity of that ancient and learned body and ensures almost universal and instantaneous acclamation.

In a short preface, the author records his mingled feelings of pride and diffidence with which he received an invitation to deliver Fitz-Patrick lectures. He remembered "with trembling solicitude, the high level and excellence of the lectures of his predecessors in office". "With what joy, what interest, what wonder we read, nearly a quarter of a century ago, Rivers's 'Medicine, Magic and Religion'; how we marvelled at the erudition and research displayed by Sir Clifford Allbutt in 'Greek Medicine in Rome'; Raymond Crawford's 'Pestilence and Plague in Arts and Literature' and there are many others. We long to emulate these monuments of industry, these works which, if nothing else of their remained, would suffice to keep green the memories of their authors and we draw back afraid. In every truth, there were giants in those days." He had no difficulty in the choice of the subject. But he trembled at the magnitude of the task before him. "Here and there, scattered in medical works dealing with diseases in the tropics, we find a few notes on the history of these diseases but, speaking in any sense other than the narrowest, there is no history of the rise and development of tropical medicine. In the case of the so-called Tropical Medicine, the difficulty has been the greater because, it has necessitated tracing back, in some instances, to times of savagery, the earliest available records and to legends prior to record. In others, the first traces had to be sought in articles, in books, in references in foreign languages, works attainable with much difficulty and often only in garbled or mutilated copies, the originals of which had been lost." The author then refers to another difficulty, namely, that we have no definition of the term 'Tropical Medicine'.

Having mentioned the preliminary difficulties, he proceeds to explain his aim in the lectures (the basis of the book), "It is not our aim to give a history of diseases of warm climates but a history of tropical medicine in the generally accepted connotation of the term. The former—history of diseases in warm climates—would necessitate going over ground already well covered, discussion of malaria, plague and perhaps other diseases from the dawn of history, but the latter, the subject of these lectures is the history, that is, *the rise and development of tropical medicine.* Its starting point can only be that time when reason began to throw its light upon and illumine the darkness of empiricism, when people began to theorise regarding causation of disease, to consider the problems scientifically and that rarely takes us back more than hundred to a hundred and fifty years give due meed of praise to Captain Cook for preserving his crews from scurvy, will in no way detract honour from the work of Lind. In an analogous way, army medical officers saw much of tropical diseases in expeditions abroad in India and in Colonies and some of them wrote many painstaking works on the barracks, on food, on the care of the soldiers' health, apart from the learned disquisitions on the diseases they encountered." ...."In the course of this study, we shall take occasion to note the reciprocal effects of history and large movements and engineering undertakings on the one hand, and tropical diseases on the other, the medical aspects of the difficulties of construction of the Suez Canal and the Panama Canal and how they were

overcome, the effects of the African slave-trade in spreading disease and the conditions under which the trade was carried on."

The book is bound in two volumes, apparently for the sake of convenience in handling, rather than as a mode of arrangement of the subject-matter. The contents are distributed under 23 chapters of widely varying lengths or number of pages, the longest being Chapter VII on Yellow fever covering about 160 pages and the shortest being 20th Chapter on Suez Canal in nine pages. The first four chapters deal, in general terms, with the medical conditions in the navy, army, Africa, India, Australia, in the early days of colonization. Chapters V and XVIII describe, with varying degrees of detail and range of knowledge, some of the important diseases commonly labelled as tropical diseases. Malaria, Blackwater fever, Yellow fever, Trypanosomiasis, Leishmaniasis, Leprosy, Cholera, Plague, Undulant fever, Relapsing fever, Melioidosis, Dengue, Amœbic dysentery and Hepatitis and Ankylostomiosis form the order in which they are dealt with. Chapter XIX is entitled Tropical diseases connected with food and is subdivided into two groups. The first is called Avitaminoses and includes Beriberi, Epidemic Dropsy, Pellagra and Scurvy. The second sub-group deals with poisonous foods (ginger paralysis, etc.). The next three chapters (Chapter XX, XXI and XXII) are of a general nature devoted respectively to the Suez Canal, the Panama Canal and the Slave-trade. The last chapter (XXIII) containing brief biographies of Jacobus Bontius, David Bruce, James Carroll, Oswaldo Cruz, John Everett Dutton, Juan Carlos Finlay, Garcia de Orta, William Crawford Gorgas, Jesse. W. Lazear, William Leishman, James Lind, Patrick Manson, Hideyo Noguchi, Walter Read, Ronald Ross.

D. V. S. Reddy.

Plant Science Formulae. By R. C. McLean and W. R. Ivimey Cook. (MacMillan & Co., London), 1941. Pp. vii + 203. Price 7*sh.* 6*d.* net.

This is a useful little volume which most laboratory workers in botany will find handy on their bench. For its size a book of this nature can scarcely be made anything like exhaustive but on the whole the selection of matter has been carried out judiciously, and the reader will be grateful for many practical hints not easily found in books on botanical technique.

As a university teacher, the reviewer particularly welcomes the suggestion (p. 141) that the devising and constructing of laboratory equipment should form a part of the training of all postgraduate students. The plea for a well-equipped workshop attached to every botanical laboratory is also fully justified.

B. Sahni.

Sir Shanti Swarup Bhatnagar Commemoration Volume. Edited by Drs. V. S. Puri and P. L. Kapur. (Indian Chemical Society, Lahore Branch), 1941. Pp. vi + 112. Price Rs. 2-8-0 or 5*sh.*

The Commemoration Volume published by the Indian Chemical Society, Lahore Branch, and presented to Sir S. S. Bhatnagar on the occasion of his appointment as Director of Scientific and Industrial Research, Government of India, is a fitting tribute to the many services of Sir Shanti Swarup to the cause of Chemistry in the Punjab. This volume is the outcome of the high esteem in which he is held by the chemists of the Punjab. The Chemistry Laboratory of the Panjab University, the standing monument to the many achievements of Sir Shanti Swarup in the field of chemical research, has produced a band of workers who would add lustre to his inspiring leadership. This volume gives but a glimpse of the numerous investigations in the domain of chemistry that were directly or indirectly inspired by him.

In this volume there are 12 original papers and 2 reviews. The latter are on the importance of Magnetic Measurements for Chemical Problems and the Recent Applications of Colloid Chemistry to Textile Problems. Both these reviews summarise and bring into prominence the important work done in the Chemical Laboratories on these subjects. Other papers cover a wide range of subjects including Soils, Biochemistry and Corrosion Problems. The volume opens with a paper on Adsorption by Precipitated Hydroxides of Copper and Bismuth by Yajnik and his co-workers. It is followed by a paper on the Influence of Magnetic Fields on Adsorption. This is a subject on which Sir Shanti Swarup has done monumental work. The paper contains several references to the previous work

done by Bhatnagar's School. The effect of Inorganic Colloids on the Electro-Deposition of Metals has been ably dealt with by V. S. Puri and his co-workers in his two papers on the subject. Dr. Balwant Singh has contributed the 10th part of his extensive investigations on the Potentiometric Studies in Oxidation-Reduction Reactions. The paper deals with iodometric determinations of oxidising substances. Dr. Gaind has given Part VI of his investigations on Local Anæsthetics with which he has been associated for a long time. A. N. Puri and Asghar have contributed two papers on the Interaction between Oxalates and Soils and Heat of Neutralization of Soil Acidoids. They have produced experimental evidence to show that soil acidoids behave like ordinary acids as regards their heats of neutralization. Kapur and Mathur have studied the Corrosion of Copper and given results of their study on the corrosion of copper by glacial acetic acid. They have shown that percentage of corrosion regularly increases with time. They have also found that concentration accelerates the corrosion of copper. The role of oxygen has also been brought out.

The Commemoration Volume is well printed and well bound and should adorn the book shelves of Sir S. S. Bhatnagar's numerous admirers, students and co-workers.

A. N. PURI.

Education in India: 1937-38. Prepared by John Sargent, Educational Commissioner with the Government of India. (Published by the Manager of Publications, Delhi.) Price Rs. 2-8.

The Bureau of Education, under whose auspices this Report is published, has done good service to the country in bringing out this publication. It deals with education in British India during the official year 1937-38 and covers the usual ground in the usual way. It takes a wide sweep over all types of education: primary, secondary and collegiate, the education of girls and women, the training of teachers, professional and technical education, and the education of certain special communities. It also deals with the personnel and organization of education as well as with certain miscellaneous activities of an educational character.

Up till now the latest authoritative source of information had been the Quinquennial Report for the period 1932–37. Now the present volume brings our information about educational matters nearer to our own times by one more year. It is a pity, however, that this Report has appeared so late. An explanation for the delay is no doubt given in the Preface, but still it is desirable to have these annual Reports as soon as possible after the close of the official year to which they relate. Their utility declines with the time that elapses. An annual Report is like a clinical thermometer which a doctor uses in order to take periodical temperatures of his patient. If the thermometer is not made available in time the progress of the patient cannot be followed and his treatment cannot be intelligently undertaken.

Certain suggestions may now be given with a view to make the Report under review more generally useful to the public. Official Reports often repel the reader because of their unattractive presentation of material. A Report need not be very much different from a book. The Reports prepared under the auspices of the Board of Education in England, for instance, are like books in regard to their format and presentation of matter. The chapter heads for all major topics or divisions of the subject are given boldly as in a book. The same procedure may be followed here. An index may also be provided for ready reference. In the Preface it is mentioned that the Appendices to the present Report are printed in a separate volume. It is necessary to indicate in this volume what those Appendices contain.

Throughout the Report the education of girls and women is referred to as education of "females". Since it is unlikely that the fair sex will be pleased with this appellation it is better to change the terminology.

The price of the Report, Rs. 2-8, is far too much even in these days of paper scarcity and high cost of printing. Finally, the utility of the Report can be considerably enhanced if statistics regarding Indian States could be incorporated and the progress of education in them also could be taken into consideration.

D. S. GORDON.

Magnetism in Relation to Chemical Problems. By K. N. Mathur. Lucknow University Studies, No. VIII. (The University of Lucknow), 1940. Pp. 185.

Chemists are just as much interested in effecting reactions between molecular units in order to study the results or in order to produce some new desired type of molecule, as in knowing the fundamental nature of the molecular units so that they can intelligently follow the chemical reactions taking place. For this latter object every available physical method of study is pressed into service. One of these useful methods is the study of the magnetic properties. Such studies give us a valuable insight into the nature of the different types of chemical links, the structures of the molecules, and of inter- and intramolecular forces. Prof. Mathur has presented in this brochure a very clear account of the fundamentals of the subject, the experimental techniques, and some of the outstanding results of the studies, and in a manner that will hold the interest of many chemists who have no specialised knowledge of magnetism. The opening chapter deals with the fundamental units and experimental methods and is followed by other chapters discussing diamagnetic and paramagnetic properties. The closing chapter is on magnetism in relation to chemical equilibria.

The book is neatly got up and will prove an useful addition to the library of many chemists.

RECENT ADVANCES IN PHYSIOLOGY

Recent Advances in Physiology. Edited by James Murray Luck and Victor E. Hall. (American Physiological Society and Annual Reviews Inc.), 1941. Vol. III. Pp. viii + 784. Price $5·00.

THE third volume of this Annual Review has been as informative and successful as its predecessors and the Editors are to be congratulated on bringing out such an excellent publication in spite of the difficulties associated with the present critical conditions due to war. The Editors have chosen acknowledged authorities in writing the reviews, *cf.* Fenn on *muscle,* Feldberg on *histamine,* Marshall on *chemotherapy* and Jasper on *electrical activity of the brain.*

The first chapter on the Relation of *Bioelectric Potentials to Cell Functioning,* by Bishop, deals mainly with the character of the potential and the course of excitation. Dealing with the interaction between electrical processes and chemical environment, Bishop refers to the work of Sir Henry Dale and quotes experimental evidence which tends to lead to a conclusion contrary to the view held by the Dale School that acetylcholine is the precursor of potassium at the neuromuscular junction. A brief but an illuminating account on constructing an artificial synapse, illustrates the modern methods employed for a study of the controversial question of synaptic transmission. In the next chapter Laurens dealing with the *Physiological Effects of Radiant Energy,* refers to the effects produced by ultra-violet radiations of different wave-lengths and specially as they affect skin, eye, blood, metabolism, and also on bacteria, fungi, protozoa and proteins. The effects on the skin naturally leads one to the question of histamine or H substance being produced by ultra-violet radiation. The author believes, from the analysis of available data, that a chemical substance is involved in producing these reactions, this substance being either a protein or a simple protein derivative. But whether the substance is histamine or not, cannot be said at present. From a practical point of view, interesting developments are taking place regarding the action of ultra-violet rays on bacteria. It is now claimed that hospital wards and operating rooms can be 'disinfected' by radiations, although their mode of action still remains obscure.

The next two chapters on *Physiological Aspects of Genetics* and *Developmental Physiology* are written by A. H. Sturtevant and E. Witschi respectively. A very wide field in Genetics, sex in algæ and hymenoptera, self-sterility, tumors and leucaemias in mice has been covered. The most interesting contribution in human genetics is the electro-encephalographic patterns shown by patients who are liable to get epilepsy. Witschi has briefly summarized the work on fertilization and on parthenogenesis and polyploidy. Mechanics of gastrulation, fractionation of the organizer and chemical

nature of the organizer have also been described. The work on the influence of hormones on artificial masculinization and feminization among amphibians, especially salamanders and frogs will, no doubt, attract considerable attention.

C. E. Palmer and A. Ciocco have reviewed the work on *Growth*. Observations by various workers on the growth of children recorded from different view-points and the influence of factors like hormones and diet, vitamins, etc., have been described.

J. C. Scott and H. C. Bazett have written the chapter on *Temperature Regulation*. The role that hypothalamus plays in regulating mammalian temperature is now fully recognised. The centre for reactions to heat, is situated in the anterior hypothalamus and that for cold in the caudal part of the lateral hypothalamus. The process involved in the stimulation of thermoregulatory mechanism, however, is still under controversy and the idea that the temperature of the inflowing blood determines the activity of the hypothalamic centres is not fully acceptable. Physical and chemical regulation of temperature and slow adaptations to external temperature have been very lucidly discussed and will be of considerable interest to those who are working on basal metabolic rates in the tropics.

Discussing *Energy Metabolism*, T. M. Carpenter describes the basal metabolism in laboratory animals and reviews the experimental work relating to fasting, food, season, climate and environment.

A very interesting review on *Respiration* dealing with nearly 200 references has been written by C. F. Schmidt and J. H. Comroe. These authors have paid particular attention to three subjects, *viz.*, (*i*) location and functional integration of the regulating mechanism in the central nervous system, (*ii*) nervous and chemical factors involved in pulmonary ventilation, and (*iii*) physiology of respiration at high altitudes. In spite of the traditional idea of a 'centre' being a sharply localized structure, it is now admitted that the respiratory centre is not a localized structure but a long chain of nerve centres. Lumsden's work published in 1923 has been confirmed by other workers. A reciprocal innervation between the inspiratory and expiratory neurons in the medulla has been described. The chemical stimulus to the respiratory centre is now accepted to be CO_2 acting as such and not the hydrogen ion. The hyperpnœas of muscular exercise and anoximia are attributed to excitatory reflexes rather than to chemical stimulus. The very important review on physiology of respiration at high altitudes covering a large number of papers is of topical significance.

While discussing the *Physical Properties of Protoplasm*, E. F. Adolph refers to the optical, mechanical and electrical properties of protoplasm. W. O. Fenn dealing with *Muscle* quotes the work dealing with the relation between the factors of length, heat and tension. He has also discussed briefly the mechanism of myoneural transmission of excitation and the distribution of electrolytes in resting and contracting muscles.

J. E. Thomas reviewed the work on the *Digestive System*. He refers to the papers dealing with motor and secretory activity of the stomach and intestines and also to the work dealing with experimental production of peptic ulcers. *Liver and Bile* are dealt with by W. B. Hawkins. He has reviewed the work of liver injuries, bile, prothrombin and heparin. The clinical application of some of the experimental observations reported in this review demands serious attention from clinicians.

The data of G. M. Higgins on cytological characteristics of the blood of experimental animals will prove useful to those engaged in the study of blood dyscrasias. Very important data regarding erythrocytes, reticulocytes and hæmoglobin are included in the review. Similarly, recent work on neutrophylic leucocytes, lymphocytes, mononuclear leucocytes, platelets and experimental leucæmias is included and the influence of vitamins on formed elements of blood has been discussed. C. J. Wiggers and H. D. Green have contributed the chapter on *Heart*. They have discussed the physiological properties and innervation of the heart, cardiodynamics, heart sounds, and electrical phenomena. The coronary and pulmonary circulations receive special attention.

Peripheral Circulation has been allotted a special chapter written by V. E. Hall. Venous and arterial circulations are first discussed followed by vasomotor mechanism and vasomotor reactions. Circulation in special regions like the spleen, kidney, skeletal muscles, etc., are then dealt with and a brief discussion on shock follows.

Electrical Activity of the Brain is a comparatively new subject in the field of physiology but the 176 papers very ably reviewed by H. H. Jasper, illustrate the keen interest taken by physiologists in general and American physiologists in particular, in this subject. Jasper has first summarized the results obtained after local stimulation of the brain. General factors affecting spontaneous cortical rhythms are then mentioned. Clinical studies include localization of cerebral lesions, epilepsy and psychiatric disorders.

The review of the *Autonomic Nervous System* and the 325 references given by D. Sheehan deals with a variety of subjects and the technique employed in physiological research. Researches on autonomic nervous system have been of special interest to clinicians especially in recent times with very advanced surgical skill. Pain is a subject of universal interest and Sheehan has begun his review with visceral afferents. That the impulses along visceral afferent fibres may produce responses in somatic as well as visceral effectors just as somatic afferent impulses may elicit activity in visceral as well as somatic effectors is a conclusion of considerable interest to the medical profession. Literature pertaining to visceral efferents (autonomic) has been summarized with particular reference to extremities sudomotor fibres, dorsal root potentials, striated muscle, bones and joints and different organs of the body including the endocrines. Transmission at the synapse naturally receives special attention.

Hearing, Visceral Receptors and Vibratory Sensations and Pain are reviewed by E. Barany, R. Granit and Y. Zotterman respectively and *Physiological Psychology* by H. S. Liddell.

The chapter on *Kidney* is written by L. Leiter. He has dealt with a number of subjects including anatomy, physiology and pathology of the kidney. Ischaemic hypertension and kidney extracts have come into prominence in recent years because of their role in elucidating the causes of human hypertension and this subject has been very methodically summarized.

Metabolic Function of the Endocrine Glands are reviewed by S. Soskin. He has dealt with the pancreas, adrenal cortex, thyroid and the anterior hypophysis.

Endocrine Aspects of the Physiology of Reproduction form the subject of review by O. Riddle. The very extensive and intensive work done in this important branch of physiology are condensed in about 40 pages quoting nearly 200 references and Riddle confesses that he has only dealt with a part of the literature published during the year. Sex hormones are first considered in relation to the adrenal and the pituitary gland. Interesting reviews on calcium metabolism and sex hormones and on the action of sex steroids on blood fat follow. Prolactin, mammogenic hormones and neural relationships are briefly discussed and types of reproductive behaviour mentioned.

Reproduction in Mammals is a contribution by M. H. Friedman. The central nervous system and reproduction are discussed first followed by environment and seasonal rhythms. The relation between diet and reproduction is stressed. The indirect criteria of human ovulation are summarized briefly but obviously none of the criteria suggested so far have received all-round scientific confirmation.

E. K. Marshall, Jr., who has now been accepted as the leading authority on chemotherapy has contributed the chapter on *Bacterial Chemotherapy*. The review is restricted to three important sulphonamides, *viz.*, sulphanilamide, sulphapyridine and sulphathiazole. These have been reviewed in relation to their toxicity, absorption, excretion and distribution in the body. The mode of action of sulphonamides is briefly discussed.

W. Feldberg has contributed a chapter on *Histamine and Anaphylaxis*. He has discussed the evidence for liberation of histamine in anaphylaxis in various species. The responses of smooth muscle preparations to histamine and antigen are then mentioned. The review on allergic conditions in human beings will be of great interest to clinicians.

The last chapter on *Exercise* is written by A. H. Steinhaus. He has reviewed the different practical aspects of exercise and has briefly discussed the adjustments of the body during and immediately following exercise. Recent work in the nature and estimation of fatigue is briefly reviewed. Reference is also made to pathology, therapeutics and biomechanics of exercise.

B. B. DIKSHIT.

RADIAL OSCILLATIONS OF A STAR AND THE FORMATION OF THE PLANETARY SYSTEM

BY

H. K. SEN

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THE solar system, as we know, is isolated in space, and possesses certain regular features.[1] The first theory relating to the origin of the solar system was that of Laplace-Kant[2] according to which, the solar system was originally a huge sun which broke up as a result of its rotation. The Laplace theory, while explaining most of the regular features of the solar system, failed to explain an equally conspicuous feature, *viz.*, that almost the whole of the angular momentum of the system is contributed by the four major planets, which have less than one-seven hundredth of the total mass of the system. In the words of Spencer Jones,[3] "the origin of the solar system is not to be explained by the gradual cumulative action of internal forces: an explanation must be sought in the swift catastrophic action of forces from outside."

The catastrophic action was supposed to have been brought about by a very close passage of another star to the sun; this assumption has been made in the planetesimal theory of Chamberlin[4] and Moulton[5] and the tidal theory of Jeans[6] and Jeffreys.[7] The planetary ribbon was supposed to be formed between the sun and the passing star, out of which the planets condensed. But the passing star could give, as Russell[8] pointed out, only one-tenth of the average angular momentum per unit mass possessed by the planets. On Russell's suggestion Lyttleton[9] advanced the "enticement theory"* of the solar system. The sun was pictured as a binary star. The visiting star had a large mass and velocity so as to provide enough energy for the shearing of planetary material. The sun was supposed to have been just so far off as to escape capture by the visiting star but nevertheless to gain chunks of the planetary ribbon. The validity of this assumption has been questioned by Luyten.[10] Bhatnagar[11] has shown that even under the most favourable conditions there would be a catastrophic collision between the three bodies. From astrophysical considerations Spitzer[12] has drawn the conclusion that the planetary ribbon, if formed, would dissipate into space in a period of the order of an hour at the most at stellar temperatures.

In a recent and interesting paper, A. C. Banerji[13] has opened up an entirely different line of approach to the problem. The sun is supposed to be originally part of a Cepheid Variable of about nine times the sun's mass, oscillating with small amplitude. The nearby passage of a star of about the mass of the Cepheid increases the amplitude of the Cepheid's oscillations. The passage of the second star need not be grazing or very close, but only sufficiently near to produce appreciable tidal protuberances in the Cepheid. Banerji has shown that under these conditions dynamical instability is caused in the Cepheid's oscillations resulting in ejection of matter of the sun's mass from it. The planets are supposed to be formed out of the part of the ribbon attached to the sun's mass. The visiting star has sufficient angular momentum to impart the necessary momentum to the planets. It has also been shown that the solar system will have to take about two-fifths of the energy of the parent Cepheid to escape from the latter. A specially remarkable feature of the theory is that it makes a less number of assumptions than any other existing theory. The parent Cepheid will also have a planetary system of its own and the probability of there being other planetary systems than our own is definitely increased.

Observation has not so far disclosed any other planetary system similar to the solar system. Russell[14] is of the opinion that, even if there be planetary systems in some of the distant stars, they will not be visible even through the most powerful telescope that we can construct. But theory may well open fresh avenues for observation, and we are hardly entitled to pass verdict against a theory of the origin of the solar system merely because it points to the possibility of a plurality of such systems. In most of the theories "so many special assumptions are involved that it has been remarked that the solar system had a very narrow escape from never coming into existence."[15] Banerji's theory is unique in that it makes the birth of the solar system definitely more probable.

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* Knox-Shaw.

1 Jeffreys, *The Earth*, 1929, p. 16.

2 Jeans, J. H., *The Problems of Cosmogony and Stellar Dynamics*, 1919, p. 1.

3 Jones, H. S., *Life on Other Worlds*, 1940, p. 219.

4 Chamberlin, *Ap. J.* 1901, **14**, 17.

5 Moulton, *ibid.*, 1905, **22**, 165.

6 Jeans, J. H., *The Problems of Cosmogony and Stellar Dynamics*, 1919, p. 275.

7 Jeffreys, *The Earth*, 1929, p. 16.

8 Russell, H. N., *The Solar System and its Origin*, 1935, p. 113.

9 Lyttleton, R. A., *M.N.*, 1938, **98**, 536.

10 Luyten, *ibid.*, 1939, **99**, 692.

11 Bhatnagar, P. L., *Ind. J. Phys.*, 1940, **14**, 253.

12 Spitzer, L., *Ap. J.*, 1939, **90**, 675.

13 Banerji, A. C., *Instability of Radial Oscillations and the Origin of the Solar System.* (To be published.)

14 Russell, H. N., *The Solar System and its Origin*, 1935, p. 113.

15 Jones, H. S., *Life on Other Worlds*, 1940, p. 234.

CENTENARIES

Bell, Charles (1774-1842)

CHARLES BELL, the British discoverer of the functional specialisation of the nerves, was born in Edinburgh November 1774. He inherited from his mother a passion for drawing. While still a student he published his *System of dissections* (1798) illustrated by his own drawings. Four years later he published a series of engravings of the nervous system including the brain to illustrate the lectures of his brother John, the anatomist. In 1804 he contributed the portion on the nervous system to his brother's book *Anatomy of the human body*.

His book *Anatomy of expression* (1806) explained in a pleasant style and with striking pictures the mechanism of the movements of expression and criticised the works of art from that point of view. This was the first book of its kind. It went through several editions. The readers of *Current science* will be interested to know that the Nawab of Arcot procured a copy and had it bound in red morocco and satin. His *New idea of the anatomy of the brain submitted for the observations of his friends* (1811) announced his discovery that "the nerves are not single nerves possessing various powers, but bundles of different nerves distinct in office and that the nerves of sense, the nerves of motion and the vital nerves are distinct throughout their whole course." Thus was established for the first time, the existence of sensory and motor nerves. He continued his investigations for a number of years and gave the full result in 1830 in his *Nervous system of the human body*. Bell himself estimated its value with the words "they will hereafter put me beside Harvey". He was knighted and was presented the Royal Society's medal in 1829.

He wrote several books and after he took up the chair of surgery in the University of Edinburgh he published the *Institutes of surgery* (1838) and the *Practical essays* (1841) which were based on his observations in the wards.

Bell died of anginopectoris at Hallow Park, 28 April, 1842.

Baird, Andrew Wilson (1842-1908)

ANDREW WILSON BAIRD, a British Indian engineer, was born at Aberdeen 26 April, 1842. He received his education at the Military college of the East India Company at Addiscombe and at the Royal Military Academy at Woolwich which absorbed it in 1861. He arrived in India early in 1864 as special assistant engineer of the Bombay harbour defence works and the reclamation work of the harbour foreshore. Having seen field service as railway engineer in Abyssinia in 1868 he joined the Great Trigonometrical Survey of India in 1869. When the Survey undertook tidal observations for determining the mean sea level as a datum for the survey, Baird was deputed to study the subject including reduction by harmonic analysis, under Lord Kelvin. Baird's book *Manual of tidal observations and their reduction by the method of harmonic analysis* came out in 1886. His work, which first began in the gulf of Cutch, was later extended to all the principal Indian ports, from Aden to Rangoon. He contributed to the Royal Society a paper on the tidal repercussions on India of the great volcanic eruption of Krakota in Java. Baird's tidal investigations in India by new methods are acknowledged as pioneer work which led to extensive international developments along similar lines.

From 1885 to 1897 Baird was employed successively in the Royal Mint in Bombay and Calcutta. He died suddenly of heart failure in London 2 April 1908.

S. R. RANGANATHAN.

University Library,
Madras.

INTER-UNIVERSITY BOARD, INDIA

TWENTY-SEVEN subjects have come up for discussion before the Board at the 17th annual session held at Annamalainagar in January 1942, but most of these possess narrow administrative rather than broad academic importance. Among these subjects reference may be made here to a few outstanding ones. The question of securing a certain amount of uniformity in the subjects of study for the Matriculation Examination deserves support; but the sub-committee's recommendations in this respect are not quite satisfactory in regard to the compulsory group, and still less satisfactory in regard to the optional group. In the latter case the committee seems to have overstepped its limits and indicated not only the material to be taught but in one instance also the manner in which it should be taught.

The desirability of founding an Inter-University Publication Trust Fund was a matter upon which various opinions were expressed by the universities. This is rather unfortunate; for it seems reasonable to expect that universities should be interested in the dissemination of knowledge and that they should welcome the publication of their research work by a central organization such as the Inter-University Board. The publication, however, must not be restricted to the theses submitted for the higher degrees as suggested in the resolution, but must extend to all useful knowledge which would further the interests of university education.

Thus, for instance, a question which came up for discussion was the desirability of co-ordinating the work of training colleges and standardizing the degrees granted by Indian universities in Teaching. For an intelligent consideration of this problem the Board must have before it up-to-date information regarding present practices in various parts of India. It is right and proper that money must be made available for the preparation of a booklet which would give this information.

It may be argued in this connection, that the Bureau of Education under the Government of India does this kind of work in its annual and quinquennial Reports. But it must be remembered that the Bureau is mainly interested in education below the university standard; nor is it interested in collecting and presenting that kind of information which university authorities need.

In the budget statement set forth on page 69 of the Report under review it may be noticed that out of nearly Rs. 20,000 that was spent during the year, no less than Rs. 15,000 was devoted to such items as honorarium, salaries, and travelling expenses. The only publication of some value, upon which a sum of Rs. 2,000 has been expended, is the "Handbook of Indian Universities".

D. S. Gordon.

SCIENCE NOTES AND NEWS

Classical and Quantum Mechanics.—The analogy between classical dynamics and quantum dynamics has been pursued far enough, and it is well known that all the main principles and results of the classical theory reappear in the quantum theory in a generalised form. One such important result is that the Hamilton-Jacobi partial differential equation of classical mechanics follows from Schrödinger's wave equation in the process of going to the limit $\hbar \rightarrow 0$. An alternative and fruitful method of looking at this relationship has been recently given by Whittaker (*Proc. Roy. Soc. Edin.*, 1941, 61, 1) who has shown that, by suitably modifying Hamilton's principal function, the differential equation satisfied by it is *rigorously* equivalent to Schrödinger's wave equation. The modification is based on the use of the quantum mechanical commutation rule, and hence, in principle, Whittaker's method is equivalent to the older methods but it appears to be mathematically a more powerful method, and leads to several applications in pure mathematical analysis. Whittaker's method uses a remarkable result due to Dirac relating to the probability amplitude $(q|Q)$ namely that its logarithmic derivatives with respect to q and Q furnish the momenta p and P. Here q and Q are the co-ordinates at instant t and the previous instant T respectively. As applications of the theory are given very elegant quantum mechanical deductions of the Mehler and Lebedeff formulæ for the Hermite and Laguerre functions respectively.

The power of Whittaker's method is illustrated in another paper by Copson (*ibid.*, pp. 37-54) who has shown that the method provides a very simple and direct way of finding an elementary solution of the general partial differential equation of the parabolic type. Since from the analytical point of view the Planck's constant $\hbar$ appearing in the commutation relation may be any constant real or complex, the algebra used is the one which is given by $pq - qp = 1$.

In a further paper in the same issue (p. 61), Erdélyi has considered continuous orthogonal systems and derived formulæ relating to bilinear generating functions (of the type of Mehler's celebrated formula) associated with such systems. He has obtained the very interesting result that Whittaker's proof of the derivation of the Mehler formula applies almost literally to the continuous case also, and yields the bilinear generating functions of parabolic cylinder functions and of confluent hypergeometric functions.

B. S. M.

The eradication of Lantana has been a vexed problem of Indian land management which till now has defied a complete and satisfactory solution. High hopes were once entertained of biological control through an imported parasite but the results were disappointing. Chemical methods have also been tried and Mr. A. L. Griffith presents (*Forest Bulletin No.* 106, Sylviculture Series, Manager of Publications, Delhi, 1941. Price As. 6 or 7*d.*) the results of his experiments on the use of sodium chlorate spray in the control of Lantana. Mr. Griffith uses the word "control" advisedly to clear up some misunderstanding which arose in the early years of this work over the "rather unfortunate use which was made of the word 'eradication' in connection with it". The spray controls (in the sense that the weed is suppressed till suitable forest regeneration is established), but does not eradicate and the author presents data which work the cost of control at about Rs. 10 (with sodium chlorate at As. 8 a lb. in bulk) an acre; three sprayings are prescribed, preferably one each in February, April and September. It is stated that the spray in the concentration and technique prescribed has no toxic effect on the soil and the subsequent regeneration. Two plates of photographs illustrate the possibilities of the method but better placing and numbering of these good photographs could make a comparison of the areas much simpler than now when "Plate II, Fig. 1" is to be compared with "Plate I, Fig. 2" and "Plate II, Fig. 2" is to be compared with "Plate I, Fig. 2" and with "Plate II, Fig. 1". The pictures would retain all their point and be easier to compare if the two plates faced or immediately followed each other and

their four photographs were consecutively numbered.

Insulation and Pressed Boards from Bagasse.—In Miscellaneous Bulletin No. 44, the Imperial Council of Agricultural Research have published an account ("The Manufacture of Insulation and Pressed Boards, Wrapping Papers and Straw Boards from Bagasse," by M. P. Bhargava and A. N. Nayar, Delhi; Manager of Publications, 1941. Price Re. 1-4-0 or 2 *sh.*) of the experiments carried in conjunction with the Forest Research Institute, Dehra Dun, on the utilisation of Bagasse; after thorough experimentation in the laboratory and with pilot plants and a study of the trade aspects of the problem, the authors reach conclusions which indicate that there are quite a few hurdles to be cleared before any such industry could be pioneered in the country. Technically there are no insuperable difficulties; the research data compiled in the Bulletin show that insulation boards suitably moisture-proofed, treated against decay and even made fire-resistant could be manufactured from out of bagasse. The smallest economic unit for the industry would be a plant with an annual capacity of about 1,600 tons (1,000 tons of pressed boards and 600 tons of insulation boards); as against this, it is estimated that the present maximum demand in India is about 1,000 tons a year (all of which is met by imports). The market will have, therefore, to be "nursed" and developed before it can absorb the minimum economic output of even one Indian Factory. Further, in the case of those sugar mills which use up all their bagasse as fuel, the money value to the mill, of the bagasse might be as high as Rs. 14 a ton, a figure which is double the price of Rs. 7 a ton, which the authors expect, is normally sufficient to cover the cost of the supply of bagasse from the sugar mill to the board mill. Lastly, there is the high price of chemicals most of which have at present to be imported. It will thus be seen that every one of these aspects have to be very thoroughly explored before venturing on a commercial pressed board mill. And this Bulletin provides the basic data on which the prospects of such pioneering enterprise could be assessed. In a flap cover at the end are placed small samples of bagasse insulation board, bagasse pressed board, and 100 per cent. bagasse wrapping paper; these samples (which compare very well in appearance with the imported material of well-known brands), while making the Bulletin somewhat uncouth to handle, are practical proof of the possibilities of Indian bagasse in the manufacture of boards and allied products.

Effect of Fumigation on *Tribolium confusum* Duv.—A series of experiments was carried out to determine the effect of sublethal doses of HCN gas on the fecundity of *T. confusum* Duv., and the viability of the progeny of fumigated individuals at a temperature of 27° C. (80·6° F.), and a relative humidity of 75 per cent. The results showed that fumigation at the higher dosage, either reduced fecundity, or decreased the viability of the progeny, as the average number of live progeny (larvæ, pupæ and adults), per female was only 15·4 after 65 days, as compared with 27·9 in the controls and the development of all stages was retarded. Fumigation at the lower rate had a stimulating effect, as the average number of progeny per female was 47·6 after 65 days as compared with 25·5 in the controls and the development was accelerated. It is concluded, from these results that, when granaries or store-houses are fumigated, it is essential to obtain complete mortality of the pests, either by increasing the dosage of the fumigant or by repeated treatment. Care should be taken to increase the effectiveness of fumigation by maintaining proper temperature and securing air-tight conditions, in the building, since, the insects that survive treatment may not only still be able to reproduce normally but their fecundity may even be increased (Khalilova R Acta Wniv Asiae med, 8, Zool, fasc 44, Tashkent, 1938).

Soil Research and the Thungabhadra Project.—The Thungabhadra Project, now under detailed investigation by the Madras Public Works Department, is intended for growing irrigated dry crops in the four famine-stricken districts of Bellary, Anantapur, Kurnool and Cuddapah. The soil is mainly black suitable for cotton growing.

The success of the project depends upon the satisfactory response of the soil under irrigation. To study this problem, a model farm of 90 acres has been selected at Siruguppa, in the Bellary district. The soil of the farm is typical of the area and analysis of the top three feet shows that it consists of 60 per cent. clay, 14 per cent. silt, 10 per cent. fine sand, 8 per cent. coarse sand and 8 per cent. acid soluble matter. There is facility for surface drainage of the farm and irrigation water is pumped from a nearby channel.

The experiments are intended to study the physico-chemical reaction of the deep black soils to the application of irrigation, *viz.*, the movement of salt, base-exchange phenomena, colloidal properties of the clay, field practices, manurial experiments, rotation of crops, soil management, duties of water, run off conditions, soil moisture and crop variety suitable for the irrigated conditions.

The results so far achieved at the farm tend to show that the black soils respond very favourably to light irrigation.

Water Requirements of Sugarcane.—Valuable results on the exact water requirements of various crops under field conditions have been obtained by experiments at Padegaon in Bombay Presidency. Suitable devices for measuring water were designed and employed for this work.

Accurate measurement of quantity of water required for different cane crops under different treatments was one of the major problems studied at the Sugarcane Research Station at Padegaon.

The arrangement made at Padegaon for giving measured quantity of water to sugarcane crop is intended for a rotation of three years. It consists of 216 plots which could be given measured quantity of water at different

rates and intervals with the help of meters. Water from the distributory is first taken into a receiving tank and is then carried through a Hume pipe line to a number of intermediate tanks, built in a line parallel to the plots and spaced at suitable distances. It is through these tanks that water is given to the different plots through meters. Each of these small tanks takes care of two plots. There are 108 tanks provided for the three-year scheme, with 18 tanks in each row.

Studies on the Propagation of the Mango.—Among a large number of interesting aspects of the propagation methods of the mango studied at the Kodur Fruit Research Station (Cuddapah District, Madras), the matter of eliminating variations from root stocks and ensuring uniformity therein, has been receiving much attention (B. G. Naik, *Ind. Jour. Agr. Sc.*, 11, Pt. 5). The mango being ordinarily a cross-fertilised plant gives rise to a progeny of plants of mixed characteristics and the seedlings ordinarily used as stocks for grafting upon, are therefore not at all uniform and as the characters induced by the stock in the resulting graft are concerned, the latter are of uncertain and of varying merit. One method by which this difficulty is attempted to be overcome is by making use of the polyembryonic varieties of the mango. The polyembryonic varieties produce seed, the seedlings from which are so uniform in character that they may be regarded as possessing no fertilised embryo at all. Acting upon this fact, work has related to the testing of seeds from several trees found in Malabar and South Canara which are believed to be polyembryonic. It is reported that some of these seeds gave as many as five seedlings while a large number produced two, three and four seedlings each. It was also noted that though the percentage of germination was rather low in these varieties, which is also the common belief, still at least two varieties were free from this drawback and showed a germination percentage varying from 55 to 66.

Uniformity in stock was also attempted to be secured by the method of root-grafting, with very gratifying results. Despite the limitations of this method as compared with other methods like, for example, inarching, considerable success has been obtained, about 23 per cent. of the root grafts having successfully taken. It is however within our experience that the initial successes do not last and that in the course of a year or so the grafted plants die off after they are planted out in their permanent places. These present results will therefore have to be watched as to their behaviour after planting out.

The effect of sowing mango seeds with the suture pointing upwards or downwards, sowing shelled seeds, sowing seeds graded into different sizes, and different methods of budding and grafting all form part of these studies and results of much practical value are reported.

A. K. Y.

The Root-rot of Cotton as Influenced by Inter-cropping.—Experiments conducted in Khanewal and in Lyallpur in the Punjab on the effect of growing mixed crops or inter-cropping in cotton are reported to have led to very striking results in reducing the incidence of root-rot in the cotton crop (R. S. Vasudeva, *Ind. Jour. Agr. Sc.*, 11, Pt. 6). The cotton experimented with was the variety Mollisoni (*G. indicum*) and the crops grown as mixture were Sorghum, *Setaria italica*, *Phaseolus aconitifolius* and *Panicum colonum*. The sowing was all on land known to be badly infected and during the season most favourable to the spread of the disease. The cotton was sown in rows 2½ feet apart and in between every two rows the mixed crop was sown in rows or broadcasted. The mixed crops were allowed to grow for different periods upto a maximum of about three months. The percentage mortality due to the disease was not more than 5 as long as the sorghum remained on the land and after it was removed did not go higher than 22; in the controls the mortality was about 68 per cent. The other crops used also markedly reduced the incidence of the disease the phaseolus being remarkable in this respect; while the control plots of pure cotton showed a mortality of 52·5 per cent., the mixed phaseolus plot showed only from 0·5 to 1 per cent. Experiments with American cotton also gave similar results. It is also noted that the yield of cotton was higher in the mixed crops than in the pure cotton crops.

A. K. Y.

Medicinal Plants in India.—"India is a country abounding in varieties of medicinal plants and there seems to be no reason why India with such abundance of raw materials for the manufacture of drugs should not be self-sufficient as regards medicines", says the annual report of the Botanical Survey of India for the year 1940–41 just published.

Greater use of the Industrial Section of the Indian Museum, Calcutta, has been made by the commercial community in having some of their trade difficulties solved. Assistance has been given by furnishing notes and reports on economic plant products and by giving advice on substitutes for imported commodities.

The Industrial Section has particularly helped in a thorough study of developing an essential oil industry, in investigating possibilities of cultivating a number of perfume-yielding plants and in finding out sources of several indigenous vegetable dye-stuffs, of certain resin, gum and tannin yielding plants and several industrial products.

Among enquiries dealt with by the Botanical Survey are possibilities of manufacturing Agar-Agar and iodine from sea-weeds, nature and remedy of black and brown patches on the canvas supplied to the military, possibilities of the cultivation of Tung oil plants, information on oil-yielding grasses and cultivation of large number of medicinal plants.

Nearly 3,900 specimens were identified and revised during the year. Only 1,075 specimens could be distributed and the loan of herbarium specimens for purposes of critical study was restricted to Indian workers. Among a large number of exhibits added to the already rich collection of specimens in the public gallery

of the Indian Museum are samples of some important commercial fibres, certain crude drugs, common Burma timbers and plywood.

The number of publications relating to several branches of Indian botany increased during the year to 127 as against 77 in the previous year.

A bulk purchase of quinine sulphate from Java enabled the Government of India to resume distribution of quinine to the provinces and Indian States. The total of cinchona products distributed during the year was 52,303 lb. The stock of quinine sulphate at the end of the year was a little over 267,700 lb. and that of bark and cinchona febrifuge 207,872 and 8,943 lb. respectively.

School Medical Services in Provinces.—The creation of school medical services in Provinces and States is recommended by the Joint Committee appointed by the Central Advisory Board of Health and the Central Advisory Board of Education to investigate and report on the question of medical inspection of school children and the teaching of hygiene in schools.

In each major Province, the Committee says, there should be a whole-time Chief School Medical Officer to administer the school medical services which should have a sufficient number of doctors for medical inspection and treatment of school children. The Provincial Governments should bear at least 50 per cent. of the cost.

The scheme should include both primary and secondary schools and it should be a condition of recognition that each school takes part in the scheme. Medical inspection and treatment should be provided free for the children of all primary schools and of the primary departments of secondary schools. In secondary schools, particularly in urban areas, the fees charged should include a contribution towards the cost of medical inspection and treatment.

Probably fifty per cent. of the children attending school, according to the Committee, would be found to require medical attention or medical observation. It lays special emphasis on treatment and follow-up. A scheme for medical inspection without provision for treatment and follow-up, it says, is of little or no use. Schemes for treatment must include provision for supplementary feeding. All children should have a mid-day meal whether it is brought from their homes or provided at the school.

Other recommendations include the provision of school clinics particularly in urban areas, health and cleanliness parades before school starts and instruction to school children in personal hygiene.

For teachers it is recommended that hygiene should be a compulsory subject in all courses for their training and practical demonstration should form an important part. Teachers should be taught by practice to recognise defects in children and to do elementary treatment.

The physical instructor of a school should have training in the elementary principles of physiology, of the hygienic mode of life and of nutrition. Health education should find a prominent place in the programme of study for physical instructors, the aim being to develop in them the incentive and the ability to train children to practise healthful living and to enable these teachers to co-operate intelligently in medical inspection.

Central Board of Irrigation, Simla—Bureau of Information.—Information on irrigation and allied subjects from India, Australia, South Africa, America and other countries throughout the world is collected and abstracted. The *Quarterly Bulletin*, issued by the Board, includes abstracts of papers properly classified. The Bureau supplies to those interested, information on specific subjects, on request. In addition, the Board publishes Annual Reports containing technical proceedings of the Board and Research Committee meetings, and papers on various subjects of interest to irrigation engineers.

The Production of Khaki Shade from Vegetable Raw Materials.—Dr. J. L. Sarin writes:—The problem of the production of *khaki* and grey shades for the Indian army requirements from indigenous vegetable raw materials is under investigation in a number of laboratories all over the country, and a review of the work done has been published in the latest issue of the *Indian Information* (1941, 8, p. 240). From this it appears that the principal raw materials which have been examined so far are barks of mangoe, *babool, jaman, dhak, pipal, bhor, plum, tamarind* and fig, kamala flowers, etc. Some work on this problem has also been done at the Government Industrial Research Laboratories, Shahdara, Punjab. The principal raw materials tried is the galls of *Tamarix furas* and *Tamarix dioica* locally known as *main*. The trees from which the galls are obtained are found growing wild on waste land in western Punjab. At present the galls are almost wasted. About one hundred tons of them can be collected easily every year. The khaki shade has been successfully produced from them in combination with pomegranate rind, catechu, and salts of iron and copper. For the production of *khaki* shade, dye bath is prepared by extracting *main* (50 parts), pomegranate (25 parts) and catechu (5 parts) with water (200 parts) and mordanting the shade thus obtained with a solution of ferrous sulphate (½ part), copper sulphate (1 part) and potassium dichromate (5 parts). The cost of dyeing by this process is lower than by use of myrobalan which is at present the most extensively used vegetable raw material for producing *khaki* shade. The yarn and cloth dyed *khaki* by this process was sent to the Inspector-General of Stores and Clothing, Cawnpore, and the shade has been approved.

Some other colour yielding raw materials of vegetable origin that have been examined in the Government Industrial Research Laboratories, Punjab, are *dhak* flowers (*Butea frondosa*). This plant grows wild in many districts of the Punjab, and its wood is extensively used for fuel, while the flowers are employed all over the province for medicinal

purposes. It yields a yellow dye which gives a fugitive shade on cotton cloth, but this has been successfully employed in the production of oleo-butter colouring matter which is now manufactured on a commercial scale in the Punjab, and supplied to a large number of dairies all over the country.

All-India Library Conference, 1942.—With the All-India Library Conference held on 4-6 April 1942, the Indian Library Association has now to its credit the organization of five such manifestations so far. The eve of this Conference was marked by a "Book in India" exhibition held in the University building. After the illuminating presidential address by Mr. R. P. Masani, the Vice-Chancellor of the University of Bombay, the topical discussions proceeded with the veteran exponent of library movement in India, Rao Sahib S. R. Ranganathan in the Chair for the first day and covered various fields of library service in the country, not excluding such vital questions as A.R.P. measures and microfilming of documentation. Much that was said of the different types of library—the public, school, university, and technical—was of utilitarian value, and if due allowance is made for the different conditions in India, it can be said with justice that the Conference evinced trends of a learned profession. Among the resolutions of interest to science libraries are in particular those containing recommendations on the preparation of cumulative lists of scientific periodicals and pamphlets available in Indian libraries. This is yet another instance of the comprehensiveness of objectives and the unifying influence of the Indian Library Association. Special librarians and research workers alike will commend this feature of the activities of the Association; for, it gives them additional potential tools to their respective ends. G. T. K.

The Horticultural Society of India.—A Society called the *Horticultural Society of India* has been formed as from January 1, 1942, with the purpose of advancing the cause of horticulture and horticultural science in this country. The activities of the Society will include the following:—(1) Publication of a Journal, (2) arranging meetings at various horticultural centres, and (3) encouraging original investigation.

Membership is open to all persons interested in any field of horticulture and horticultural science. Pending the appointment of office-bearers by general election, an *ad hoc* Organising Committee has been formed with the following personnel. Dr. G. S. Cheema will be the Chairman of the Committee and Dr. P. K. Sen, its Secretary.

Dr. G. S. Cheema (Poona); Sardar Bahadur Sardar Lal Singh (Lyallpur); Mr. A. M. Mustafa (Quetta); Rao Bahadur H. C. Javaraya (Bangalore); Dr. V. R. K. Badami (Cuttack); Khan M. Aslam Khan (Peshawar); Mr. S. S. Bhat (Baroda); Dr. H. K. Nandi (Jorhat); Mr. M. R. Fotidar (Srinagar); Dr. S. Hedayetullah (Dacca); Thakur R. S. Singh (Lucknow); Mr. K. S. Naik (Madras); and Dr. P. K. Sen (Sabour).

Prof. A. B. A. Haleem, Pro-Vice-Chancellor of the Aligarh Muslim University, has been elected Chairman of the Inter-University Board of India for the year 1942-43. Mysore has been selected the venue for the next annual meeting of the Board.

Fellowship in Sugar Technology.—Messrs. B. C. Joshi and Suresh Chandra, final year students of the Fellowship course of the Imperial Institute of Sugar Technology, have been awarded the *Fellowship in Sugar Technology,* in consideration of the theses submitted by them.

Indian Central Jute Committee.—Mr. B. B. Das Gupta of the Bengal Civil Service (executive), has succeeded Mr. D. L. Mazumdar, I.C.S., as Secretary of the Indian Central Jute Committee.

MAGNETIC NOTES

The month of March 1942 was slightly more active than the preceding month. There were 12 quiet days, 15 days of slight disturbance, 3 of moderate disturbance and one of great disturbance as against 6 quiet days, 18 of slight disturbance, 6 of moderate disturbance and one of very great disturbance during March of last year. The day of largest disturbance during March 1942 was the 1st when a magnetic storm of great intensity was recorded, and that of least disturbance the 28th. The characters for individual days are given in table below.

Quiet days	Disturbed days		
	Slight	Moderate	Great
11, 12, 15-17, 20, 22, 24, 25, 27, 28, 31.	2-4, 6-10, 14, 18, 19, 21, 23, 29, 30.	5, 13, 26.	1

Two magnetic storms, one of moderate and one of great intensity, were recorded during the month of March this year as against 3 storms (1 of very great intensity and two of moderate intensity) during March 1941. The mean character figure for the month of March 1942, is 0·74 as against 1·03 for March of last year.

M. R. RANGASWAMI.

SEISMOLOGICAL NOTES

During the month of March 1942, three moderate and three slight earthquake shocks were recorded by the Colaba seismographs as against one moderate and five slight ones recorded during the same month in 1941. Details for March 1942 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
March 1942		H.	M.	(Miles)		(Miles)	
6	Moderate	01	18	4280	..	140	
7	Slight	01	39	5740	..	..	
20	Slight	06	43	6450	..	..	
22	Moderate	04	51	3660	..	..	
22	Moderate	07	38	1250	Near Lat. 36°·5 N., Long. 70°·5 E. in the Hindukush	120	Reported to have been felt at Simla, Lahore, Rawalpindi and in the Kurrum Valley
30	Slight	05	57	1510	..	..	

ASTRONOMICAL NOTES

Planets during May 1942.—Mercury will be in the western sky at sunset and will be visible as reddish star of the first magnitude. It reaches greatest elongation east of the Sun (22° 11′) on May 18 when it will set about an hour and a half after the Sun; this will be a favourable opportunity for observing the planet without difficulty.

Venus continues to be a prominent object in the eastern sky for over a couple of hours before sunrise and on May 11, there will occur a close conjunction of the moon with the planet.

Mars is slowly getting near the Sun, but can still be seen in the early part of the night as a red star of second magnitude in the constellation Gemini. Jupiter is also approaching close to the Sun and will be visible as a fairly bright object low down in the western sky for a short time after sunset.

Saturn and Uranus continue to be near each other; the former will be in conjunction with the Sun on May 23 and the latter on May 22 and so it will not be possible to observe the planets during the month. T. P. B.

ANNOUNCEMENTS

Distribution Maps of Major Crop Diseases.—The Second Imperial Mycological Conference of 1929 recommended that full information in regard to the distribution of diseases of crop plants throughout the world be obtained and published in a form readily accessible and up to date. In compliance with this recommendation the Imperial Mycological Institute proposes to issue a series of maps showing the world distribution of the major crop diseases.

It is hoped that six maps will be available for distribution with the March 1942 number of the *Review of Applied Mycology*, and two maps each month thereafter.

The price to subscribers of the *Review* is 3*sh.* 9*d.* per annum (3*sh.* to direct subscribers in the British Commonwealth) post free and to non-subscribers 3*d.* (2½*d.*) each map, post free. All subscriptions are payable in advance. Orders and correspondence respecting the maps should be addressed to the Director, Imperial Mycological Institute, Kew, Surrey.

Loose-leaf binders for the maps are expected to be available after the war.

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 90, No. 4604.

"Journal of Agricultural Research," Vol. 63, No. 12.

"Agricultural Gazette of New South Wales," Vol. 53, Pt. 1.

"Indian Journal of Agricultural Science," Vol. 12, Pt. 1.

"Journal of the Indian Chemical Society," Vol. 18, No. 12, Vol. 19, No. 1.

"Indian Forester," Vol. 68, No. 4.

"Indian Farming," Vol. 3, No. 3.

"Bulletin of Health Organisation" (League of Nations), Vol. 9, No. 4.

"Journal of the Indian Mathematical Society," Vol. 5, No. 4.

"Indian Medical Gazette," Vol. 76, No. 12.

"Nature," Vol. 148, Nos. 3761-65, Vol. 149, No. 3767.

"Indian Journal of Physics," Vol. 15, Pt. 6.

"Canadian Journal of Research," Vol. 19, Nos. 11 and 12.

"Science," Vol. 94, Nos. 2446-47 and 2450-52.

"Sky," Vol. 1, Nos. 2 and 3.

"Science and Culture," Vol. 7, Nos. 9 and 10.

"Indian Trade Journal," Vol. 144, Nos. 1860-66; Vol. 145, Nos. 1867-68.

"Bulletin of the American Meteorological Society," Vol. 22, No. 9.

"Journal of the American Museum of Natural History," Vol. 48, Nos. 4-5.

"Journal of Research (National Bureau of Standards)," Vol. 27, No. 4.

"Canadian Journal of Research," Vol. 19, No. 11.

BOOKS

"Chromatographic adsorption analysis," by Harold H. Strain. (Interscience Publishers, Inc. New York), 1942. Pp. x + 222. Price \$3·75.

"Chinese lessons to Western Medicine," by I. Snapper. (Interscience Publishers, Inc. New York), 1941. Pp. x + 380. Price \$5·50.

"Advances in enzymology," Vol. I, by Nord and Werkman. (Interscience Publishers, Inc. New York), 1941. Pp. x + 433. Price \$5·50.

"The analytical chemistry of industrial poisons, hazards and solvents," by Morris B. Jacons. (Interscience Publishers, Inc. New York), 1941. Pp. xviii + 661. Price \$7·00.

"Modern inorganic chemistry" (Tamil), by N. Ananthavaidyanathan. (Annamalai University), 1941. Pp. viii + 642. Price Rs. 2-8.

"Indian Scientists," by Kapur. (Sahitya Niketan, Cawnpore), 1942. Pp. 364. Price Rs. 3.

"A short history of plant sciences," by H. S. Reed. (Chronica Botanica Company, Waltham, Mass., U.S.A.), 1942. Pp. 320. Price \$5·00.

"Reference service and bibliography," Vol. I: by S. R. Ranganathan and A. Sundaram, 1940, pp. 642; Vol. II: by S. R. Ranganathan and K. M. Sivaraman, 1941, pp. 511. (Madras Library Association, Triplicane, Madras). Price Rs. 15 for both the volumes.

"Wave mechanics," by V. V. Narlikar. (Registrar, Patna University), 1942. Pp. vii + 160.

"Science for the prosecution," by Julius Grant. (Chapman & Hall, London), 1941. Pp. viii + 302. Price 15*sh.*

"Science and everyday life," by J. B. S. Haldane. (Messrs. Penguin Books, Middlesex, England), 1941. Pp. 192.

"British Scientists of the Nineteenth Century," Vol. II, by J. G. Crowther. (Messrs. Penguin Books, Middlesex, England), 1941. Pp. 233–441.

"Food, the deciding factor," a guide to rationing and food values, by Frank Wokes. Messrs. Penguin Books, Middlesex, England), 1941. Pp. xi + 144.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences: *(Proceedings)*

March 1942. SECTION A.—B. S. MADHAVA RAO: *Commutation rules for matrices related to particles of higher spins.* P. SURYAPRAKASA RAO AND T. R. SESHADRI: *Isolation of hibiscitrin from the flowers of* Hibiscus sabdariffa: *Constitution of hibiscetin.* Hibiscitrin is a new flavonal glucoside of structure 3 : 5 : 7 : 8 : 3′: 4′: 5′-hepta-hydroxy-flavone. G. V. L. N. MURTY AND T. R. SESHADRI: *Raman effect and hydrogen bonds, Part II. Mixtures of aldehydes and ketones with acceptor solvents.* There are two types of hydrogen bonds, (1) the true hydrogen bonds in which both the cationoid and anionoid centres are affected and (2) hydrogen bonds in which only the cationoid group indicates change. C. J. DASA RAO AND T. R. SESHADRI: *Fatty acids of neem oil.* The work of Khuda *et al.*, relating to the isolation of new fatty acids from neem oil could not be confirmed. R. D. DESAI, R. F. HUNTER AND G. S. SAHARIYA: *Studies in the cyclohexane series. Part VI. The stereoisomeric forms of* 4-*Methyl, and* 3-*Methylcyclohexane*-1: 1-*Dicarboxylic acids and a conclusive chemical evidence for the multiplanar cyclohexane ring.* S. S. PILLAI: *On algebraic irrationals.* S. S. PILLAI: *On a problem in diophantine approximation.* E. V. CHELAM: *Application of tensor analysis of molecular anisotropy.*

SECTION B.—G. N. RANGASWAMI AYYANGAR, M. A. SANKARA AYYAR, T. R. NARAYANAN AND A. KUNHI KORAN NAMBIAR: *The train sorghums of the* Durra *group.* G. W. CHIPLONKAR: *Age and affinities of the bagh fauna.* P. MAHESHWARI AND BALWANT SINGH: *On the internal bundles in the stem of* Rumex patientia *L.* P. MAHESHWARI: *The embryo-sac of* Euphorbia heterophylla *L.—A reinvestigation.*

Indian Association for the Cultivation of Science: *(Proceedings)*

December 1941.—K. DAS GUPTA AND S. R. DAS: *X-ray study of selenium in the liquid and colloidal state.* H. N. BOSE: *Diffraction pattern of sulphuric acid at different concentrations.* T. TIRUNARAYANACHAR: *Vibrograph used as a viscometer.* L. D. MAHAJAN: *The optical hygrometer and its working.* S. SEN: *The secondary K-absorption spectra of ferric oxide in solid and in colloidal solution.* S. R. KHASTGIR: *Studies in antenna resistance and reactance.* M. M. SEN GUPTA: *Application of the theory of random scattering on the intensity variations of the down-coming wireless waves over long transmission paths.* M. G. SASTRY: *Structure of the electronic bands of the OD molecule, Part III.*

Indian Chemical Society: *(Journal)*

December 1941.—T. L. RAMACHAR: *Studies on the photochemical activity of mixtures of vanadic acid and tartaric acid sol. Part III. Induced circular dichroism in vanadic acid sol.* Photoreduction of dichroic sol. by tartaric acid

in circularly polarised light. PRYADARANJAN RAY AND KSHITISHRANJAN CHAKRAVARTY: *Complex compounds of biguanide and bivalent metals. Part III. Copper and nickel phenylbiguanidines and their different modifications.* SRIDHAR SARVOTTAM JOSHI AND K. SRINIVASAN: *Electrochemical preparation of sodium chlorate from aqueous sodium chloride.* R. V. JOGLEKAR AND S. K. K. JATKAR: *Kinetics of hydrogenation of oils in a continuous process.* RAFAT HUSAIN SIDDIQUI AND SALAH-UD-DIN: *Studies in substituted succinic acids. Part I.* M. L. GUPTA, R. KAUSHAL AND DESHPANDE: *A method of preparing mono-ethers of methyleneglycol.* SHIAM KISHORE VASHISTHA AND SALIMUZAMAN SIDDIQUI: *Chemical examination of* Thalictrum foliolosum *DC.* Isolation and characterisation of a new alkaloid, thalictrin. B. CHATTERJEE AND A. SEN: *Variations in the electrochemical properties of hydrogen clay sols with temperature.*

January 1942.—PRIYADARANJAN RAY AND SAILAJAPRASAD GHOSH: *Complex compounds of biguanide with tervalent metals. Part X. Hydroxo-aquo cobaltic* bis*Biguanidine and its salts.* DUSHYANT NARASINGASA SOLANKI AND BHASKAR GOVIND JOSHI: *Complex formation in aqueous mercuric chloride and potassium iodide by conductivity, viscosity and refractivity measurements.* B. CHATTERJEE AND A. SEN: *The electrochemical properties of silicic acid sols. Part III. Variation in the pH, specific conductivity and total acidity of silicic acid sols with dilution and with temperature.* RAMCHANDRA SAHASRABUDHEY AND HANS KRALL: *Phenylthiocarbamides. A contribution to the study of the triad—N.C.S. Part XI. Oxidation of phenylthiocarbamide with copper sulphate, cupric chloride, copper nitrate, ferric chloride and iodine.* PARES CHANDRA BANERJEE: *Use of vanadous sulphate as reducing agent. Part IV. Estimation of titanium.* PARES CHANDRA BANERJEE: *Use of vanadous sulphate as a reducing agent. Part V.* TEJENDRA NATH GHOSH AND DEBABRATA DAS-GUPTA: *Synthesis of some four-membered heterocyclic compounds.* DIL BAHAR SINGH MITTAL: *Condensation of o-, m- and p-nitrobenzaldehydes with malonic acid in the presence of organic bases.* S. D. CHATTERJEE: *On the 'Kinetic' equivalence of bromine atoms in phosphorous pentabromide.*

Entomological Society of India

Delhi Branch (New Delhi):

January 19, 1942.—A. P. KAPUR: *Observations on the biology and control of San Jose Scale and Woolly Aphis in Kashmir Valley.* K. K. NIRULA: Aonidiella auruntii *infesting twigs of rose at Delhi.* GHULAM ULLAH: Microlarinus rhinocylloides *Hochh.* (*Curculionidœ*) *and its parasite* Prodecotoma *sp. with illustrations.* E. J. VEVAI: *Potato hopper-burn by* Empoasca punjabensis *Pruthi.* S. PRADHAN: *On the scope and the aims of studies on insect population.* P. J. DEORAS: *On fresh-water Trichoptera from Gujerat.*

U.P. Branch (Cawnpore):

February 18, 1942.—B. D. GUPTA AND R. L. GARG: *Biology and distribution of* Chilo trypetes *Bisset in the United Provinces.* K. M. GUPTA: *A lepidopterous borer of mango inflorescence at Benares.*

Royal Asiatic Society of Bengal:

March 2, 1942.—K. P. BISWAS: *Notes on the occurrence of a Cosmopolitan Blue-green Alga in the Hot Springs at Wairaki in the Thermal Region of New Zealand.* K. N. BAGCHI: *Some Indigenous Poisons used in Crimes.*

April 6, 1942.—O. R. BARON EHRENFELS: *Traces of a Matriarchal Civilization among the Kolli Malaiyalis.*

Botanical Society of Bengal:

March 7, 1942.—The Sixth Annual General Meeting of the Society was held at the Botanical laboratory, University College of Science, Calcutta, with Prof. S. P. Agharkar, President of the Society, in the chair.

The following were elected office-bearers and members of the Council of the Society for the year 1942-43.

President: Prof. S. P. Agharkar; *Vice-Presidents*: Prof. S. C. Mahalanobis, Prof. G. P. Majumdar, Mr. S. N. Bal, Dr. K. P. Biswas, Prof. S. R. Bose; *Hon. Treasurer*: Mr. I. Banerji; *Councillors*: Mr. K. G. Banerjee, Dr. B. K. Kar, Mr. M. B. Dutta, Dr. N. K. Chatterji, Mr. E. A. R. Banerji, Dr. J. K. Choudhury, Mr. R. M. Datta, Mr. A. K. Sen and Dr. S. R. Sen Gupta; *Hon. Auditors*: Dr. S. Mukherji and Dr. K. T. Jacob; *Hon. Secretaries*: Dr. S. M. Sirkar and Dr. B. C. Kundu.

Prof. S. P. Agharkar delivered his presidential address on "A plea for better organisation of Botanical Research in India".

Indian Mathematical Society: (*Journal*)

December 1941.—F. W. LEVI: *On the number of generators of a free product, and a lemma of Alexander Kurosch.* C. RACINE: *Contribution to the relativistic problem of* n *bodies* (*I*). C. RACINE: *Contribution to the relativistic problem of* n *bodies* (*II*). S. M. SHAH: *A theorem on integral functions of integral order.* S. M. SHAH: *Note on a theorem of Polya.* HANS RAJ GUPTA: *On numbers of the form* $4^a(8b+7)$.

ERRATUM

Vol. 11, No. 3, March 1942, page 107, Fig. 3, *read 'hn'* instead of *'gn'*.

SUPPLEMENT TO CURRENT SCIENCE

Vol. XI] APRIL 1942 [No. 4

A BRIEF REVIEW OF THE TECHNICAL WORK OF THE BOARD OF SCIENTIFIC AND INDUSTRIAL RESEARCH

BY

S. S. BHATNAGAR AND S. PARTHASARATHY

THE Board of Scientific and Industrial Research came into being in April 1940 as a result of the foresight of Sir A. Ramaswamy Mudaliar, the Commerce Member of the Viceroy's Executive Council. Its main functions were to advise the Government with respect to the granting of financial assistance to schemes of research in Government, private and university laboratories and to help in the development of industry generally by research. A number of Research Committees have been set up to make suitable recommendations to the Board on the schemes referred to them.

In a big country like India when one begins to organise industrial research the scope for work is immense. There are natural resources to be exploited, existing industries to be helped, and there is a great need at the present juncture for improvement in the production of articles and materials, for conditions no longer exist for easy transport of articles from one end of the world to the other, and as such a measure of self-sufficiency is desirable with regard to certain items.

The war has created peculiar situations in the country, and the three main effects which could be observed as a result are:—

(1) An accumulation of raw materials which formerly used to be sent abroad.

(2) Stoppage of import of finished articles.

(3) A demand now created by war for new kinds of articles on account of the country becoming a centre of supply for the Eastern Group of the Commonwealth countries.

Vegetable Oils.—As a consequence of the war and the pressure on shipping it was soon found that the market for oil-seeds overseas would be almost entirely closed. As a result of this, a large surplus of the vegetable oils was expected in the country. It was, therefore, thought desirable to find various applications by which the oil-seeds both as oil and seed cakes could be utilised. It is well known that vegetable oils have been in use in the soap industry for a pretty long period, but the entire output cannot be consumed by this industry, which is already producing superfluous quantities of soap. Work has been done on vegetable oils as lubricants in two different directions, (*i*) in admixture with mineral oils, for marine oils, spindle oils, etc., and (*ii*) by the addition of only suitable anti-oxidants. These have been found quite satisfactory, but the use of vegetable oils as fuels cannot be considered as a peace-time proposition as bulk for bulk the vegetable oils cost very much more. In cases of emergency, however, the position is different and as a matter of fact the use of vegetable oils as diesel fuel has been seriously considered. It is possible to use vegetable oils after cracking either by pressure as has been done in Bombay, or by chemical methods. In the former, one obtains degradation products which can be used as motor spirit or fuel, and their use as such will be of some importance if cetane and

octane values are of the right order; while the splitting carried out by chemical or enzyme methods, gives the higher fatty acids, like oleic and stearic acids. Researches on both types of work are being continued.

For denaturing alcohol, mineral pyridine is generally used, but as pyridine is not available in sufficient quantities in the country other sources have to be investigated. An investigation to find out whether the bitter principles of neem could be successfully employed in place of pyridine was carried out originally at Calcutta and has been subsequently developed at Benares. Both the oil and the seed cake have been tried but encouraging results have been obtained only with the latter.

Plastics.—On account of the increasing use of plastics in industry at present, attention has naturally been diverted to methods of producing plastics in this country as well. While synthetic resins are not available in this country natural resins and resin forming materials such as shellac, casein and oil-seed cakes are available in plenty. Satisfactory progress has been made with respect to the production of plastic materials from coffee beans, oil-seed cakes, bagasse and jute waste, but the subject of plastics is inexhaustible. Modifications of shellac wtih melamine and cyanamide have also been considered.

In order to develop synthetic resins, investigations were initiated to work out suitable conditions for the manufacture of formaldehyde by the oxidation of methyl alcohol, which is available in the country. Successful experiments on a pilot plant have already been carried out. The question of the recovery of methyl alcohol and the preparation of concentrated formalin from dilute formaldehyde solution have also been tackled successfully. Work on the large-scale manufacture of cyanamide and melamine is now being developed on the pilot plant scale. Waxes which can be used as substitutes for beeswax and carnuba, from different oils, have been produced from tallow, castor and linseed oils. Several types of resins have been developed starting with vegetable oils.

Molasses.—The growth of sugar industry in India has raised the question of the disposal of molasses. Molasses contains 40 to 50 per cent. of unrecoverable sugars as sucrose and hexose. Attention has been paid to the production of acids and alcohols by fermentation processes by the use of the right kind of culture. Semi-large-scale production of acetone has been undertaken already as a result of investigations in the laboratory. It follows as a corollary to work of this kind that there should be a collection of varied bacterial and fungal cultures and such a collection has been started at the *Indian Institute of Science, Bangalore.* Over fifty cultures have been isolated and identified, while approximately eighty-five still remain to be investigated. Preparation of yeasts and other moulds as sources of vitamin D and vitamin B-complex from molasses, have been carried out in the course of the year. Amongst other experiments of interest in this field may be mentioned the preparation of yeast and potassium salts. Two methods for the latter are being tested on the pilot plant for commercial feasibility.

Sulphur.—As is well known, the progress in industry of a country is measured by the amount of sulphur consumed by it. At the outbreak of the war, attention was paid to substitute sulphur by burning pyrites and also to the possibility of recovering sulphur from the coke-oven gases, smelter gases and from gypsum. Fortunately the discovery of huge deposits of sulphur in Baluchistan by the Director of the Geological Survey of India has shown that India has sufficient sulphur for many years' requirements.

Dyestuffs.—The Vegetable Dyes Committee which has since been merged into the Dyestuffs Committee, recommended that investigations on vegetable dyes might be confined to such dyes as will find use in the colouring of foodstuffs, in confectionery, cosmetics, hair oils, etc., so that even after the war is over, they could hold their own in the market. The fact that vegetable dyes cannot compete successfully with coal-tar dyes in commerce should be recognised and work in both the directions must be pursued having regard to their complementary uses. Barks of a few species, *e.g., Butea frondosa, Terminalia arjuna,* etc., are being examined for the preparation of tinctorial constituents in standardised form. A simplified method of preparing the colouring matter of *Kamala* has been developed and a dozen shades obtained from it.

A survey of the natural resources and the possibility of producing some of the more important coal tar dyes needed in the country will be the preliminary step before any recommendation as to the work performed can be made. Such a survey is being carried out, but in the interval a few schemes of research for producing vat dyes and others mentioned below have been in progress.

The basic material for the production of alizarine and anthracene Blue RSN etc., is anthraquinone which is an oxidation product of anthracene. It has been ascertained that anthracene is available in large quantities in India as a by-product of coal tar industry. Processes have, therefore, been worked out for the production of such dyes as can be made from the available raw material. A special plant required for this work, to give 10 lbs. of the dyestuff per day has been constructed.

A study of the literature points out that in the preparation of aniline from chlorobenzene and ammonia, the reaction could be effected in the vapour phase under pressure. This method has some advantages for one can dispense with corrosion-resistant autoclaves and use only tubes of diameter 1·5". Experiments of this kind are being carried out in Bombay and the optimum conditions for the maximum yield are being worked out.

In the synthetic dye industry, aromatic amines play an important part. As these are obtained by the reduction of nitro-compounds, the choice of the method of reduction depends on many factors. Of these the electrolytic reduction offers great scope, as it is neat, clear and controllable. The reduction of nitrobenzene to hydrozobenzene and then to benzidine has been effected using this method by the use of monel-metal cathodes. The yield of the latter compound is fairly high.

The conditions under which aniline and alcohols yield mono- and di-alkyl anilines and also the catalyst that gives maximum yield, are subjects of investigation at Calcutta.

Drugs.—Atoxyl and carbarsone used in the treatment of trypanosomiasis and amœbic dysentery respectively have been the subjects of investigation at Bangalore. For both the starting material is *p*-arsanilic acid which has been prepared from commercial nitric acid and white arsenic. Atoxyl, which is sodium *para*-arsanilate, has been prepared following the method of Yang and Lo. Using the atoxyl so prepared, carbarsone which is *para*-carbamino-phenylarsinic acid, has been obtained in good yields and suitable for clinical purposes.

The thyroid glands of Indian animals have been investigated at Madras. In the course of the investigations it has been found that

(1) the desiccated thyroid gland of Indian origin is richer in iodine than the specimens imported from abroad;

(2) thyroxin isolated is pure and crystalline.

Bhilawan shell liquid has been successfully converted to a resin which can serve as a base for lacquer varnishes, enamels, water proofing and insulating materials. Stoving enamel of exceptional qualities in point of gloss, adhesion, elasticity, heat and flame resistance has been prepared.

On the medicinal side a number of interesting products have been obtained from Bhilawanol. Special mention may be made of the arsenic derivative and the water-soluble sulphonamide prepared from the above, which have given interesting results on preliminary pharmacological investigations.

Agar-agar from a variety of *gracilaria* found along the coast of Travancore has been produced in the laboratory.

Work on the isolation of bitter active principles of the Neem-oil has progressed and as a result of this, yields of the order of 1 per cent. have been obtained as against the previous records of 0·1 to 0·2 per cent.

"Dettol" has been analysed and found to consist of soap, essential oils, alcohol and a chlorinated phenol. The right kind of chlorinated product has been obtained from coal-tar acids of Indian origin and the process is now available for exploitation.

Work on the active principles of chandni root has also been undertaken.

The preparation of yatren in the laboratory starting from phenol has been completed and the yield obtained is fairly high.

Scientific Instruments.—Vacuum and compressor pumps are the basis for an important class of scientific and industrial apparatus. Using indigenous materials, pumps as efficient as the imported variety, have been produced at Calcutta.

Investigations on X-ray transformers, especially useful for the hospital unit have been completed. Photographic plates and photosensitising dyestuffs are also being investigated.

A committee has been set up to give a fillip to radio research in India and such problems as the manufacture of valves, condensers, resistances and loudspeakers are under investigation.

Metals and Alloys.—At the instance of the Board, the *Tata Iron and Steel Co.* are now manufacturing stainless steel for the manufacture of surgical instruments of both sharp and blunt types. In addition to this steel, the same firm is making experiments to produce silicon-steel sheets for the electrical industry. Magnets are needed in the communication engineering, specially the radio and telephone industry, and also in the making of house-service meters. Manufacture of such magnets is being carried out by the *Tata Iron and Steel Co.*, at Jamshedpur. It is hoped that based on surgical steel, electrical steels and magnets as raw materials a host of new industries will develop in the country.

Essential Oils.—A comprehensive report on the essential oils industry in India has just been presented to the Board by the Exploratory Committee appointed by the Government. This report will be of great use for a planned programme of work in this field. A scheme of research which has already yielded results is the production of ionone from lemon-grass. There are two distinct stages in the experiments, namely, the preparation of pseudo-ionone from citral and acetone and the cyclisation of pseudo-ionone to ionone. Various condensing agents and different conditions of temperature and pressure have been employed to get the maximum yield.

Match Industry.—In Bangalore a process for the manufacture of potassium chlorate from salt bitterns has been developed to a pilot plant stage. Also owing to the shortage of phosphorus, yellow phosphorus from the phosphatic nodules of Trichinopoly has been investigated successfully.

Fertilisers.—Fertilisers can be either natural or synthetic depending on the source for the production of the chemicals. Of the natural fertilisers the nitrates and phosphates are the most important and in India, the former being almost non-existent, attention has naturally been diverted to making the phosphatic rock in easily soluble form. Since the P_2O_5 content rarely exceeds 23 per cent. in the rock, utmost care is required to be taken in getting the maximum amount of citrate soluble phosphate. Such attempts have been made at Bangalore and at Calcutta using different methods and they have been attended with some success. At Bangalore investigations have been carried out to manufacture ammonium sulphate from gypsum as one of the raw materials.

Of the synthetic fertilisers urea is one of the basic materials. Since urea is used in the plastics industry as well for the urea-formaldehyde resins, its importance as a basic material is still further increased. Pilot plant experiments on the manufacture of this material have been carried out at Bangalore.

Glass and Refractories.—Work on the purification of Indian Glass sands is being pursued. It was, however, found not possible to remove alumina and titania to any extent by following the older method. The Glass Committee also recommended that experiments should be tried at the *U.P. Glass Works, Bahjoi,* and the *Forman Christian College, Lahore,* to produce optical glass which was considered a shortage. Good progress has been made but the large-scale development has proved difficult owing to the difficulties experienced in removing veins, but the samples produced were considered fairly good.

The usefulness of refractory material which will resist high temperature and which are free from impurities like iron, cannot be over-emphasized. Kayanite and sillimmanite are found in great quantities in India, but investigations would be desirable to find a suitable binding material to hold these together, keeping in view the two points stated above. Towards this, experiments have been conducted, using

(1) Kayanite—calcined and ground, (2) Best grade—raw fireclay (Jubbulpore), (3) Ball-clay (Jammu) and (4) Bentonite. Out of these refractories, a few have been made, and have been found to stand the tests.

Graphite and Carbon Electrodes.—Graphite occurs in nature in some parts of India. If the carbon content is increased, carbon electrodes useful to metallurgical and chemical industries could be made.

Work has been continued on finding the suitability of carboneceous materials available in India for the production of large-sized carbon graphite electrodes. Tests carried out in the laboratory on these electrodes have been found to be satisfactory.

Similar experiments on small-scale electrodes for use in dry cells are also being conducted elsewhere. As a subsidiary to the work on the production of graphite electrodes, it was thought desirable to produce carborundum as an abrasive powder from silica and pure carbon, by heating it to a high temperature.

The method of flotation has been employed in the purification of graphite occurring in East Godavari and graphite of 99 per cent. pure carbon content has been obtained,

Rayon and Cellulose.—A grant has been made available for the production of rayon on a unit process. The plant has not arrived owing to war difficulties.

Meanwhile, by the use of a Kier investigations on the cellulose content of cellulose-bearing materials of India, such as bamboos, wood long, bagasse, wheat straw, etc., have been started. It is believed that such investigations would help in the choice of raw materials for the production of rayon, which is under contemplation.

Sodium Cyanide.—Starting with raw materials—wood charcoal, commercial sodium carbonate, hametite and nitrogen and heating at about 1000° C., a 60 per cent. yield of sodium cyanide has been obtained at Bangalore. This chemical has an important use in industry.

A large number of problems have been tackled in the laboratories of the Director of Scientific and Industrial Research which cover a vast field of industries. In the short space available here, it is barely possible to give a list of the various titles under which these problems may be classified. A number of these have reached a stage where commercial exploitation has been possible and some of these have already been assigned to various industrialists for commercial development. The following is a brief list of the various items investigated.

Air foam solution for putting out fires in petroleum storage tanks.

Laminated paper boards manufactured by the use of natural resin base.

Corrugated jute boards similarly made for use in structural work.

Laminated jute boards similarly manufactured.

Manufacture of black stoving enamel from Bhilawan nuts.

Unburstable containers suitable for throwing supplies to stranded troops frow low flying aircraft.

Laminated paper board containers for food and rations.

Identity discs, worn by members of the fighting forces for identification purposes.

Systematic study of wood impregnation by the use of indigenous and readily available resins.

Development of jute mill bobbins from treated woods.

Development of water-proof plywood for use in ship-building.

Use of vegetable oils as fuel oil in diesel engines.

Development of vegetable oil lubricants for use in internal combustion engines.

Development of vegetable oil and mineral oil mixtures for use in machine lubricants.

Manufacture of cork substitutes.

Development of wood substitutes.

Manufacture of luminous paints for use in safety-first activities and during black-outs.

Development of anti-gas cloth for wearing apparels used during gas-attack.

Anti-scatter treatment for glass windows.

Windolite substitutes for use in place of ordinary glass for reasons of safety during air raids.

Fire-proofing of fabrics such as tentage, camouflage netting, etc.

Manufacture of chlorinated wax for use in fire-proofing treatment and other applications.

Study of the composition of and products from South Indian wax.

Manufacture of furfural.

Manufacture of phthalic anhydride.

Manufacture of thinners for cellulose lecquers.

Sulphur from Indian coals.

Purification of rock sulphur from Mr. Khaitan.

Development of *Agmark* ghee adhesives.

Manufacture of chlorinated rubber.

Manufacture of carbon electrodes.

Development of a process for the manufacture of highly efficient depolarizer mixtures for dry cell manufacture.

Development of plastic compositions based on natural resins.

Development of bagasse resin and its products.

Manufacture of plastics from oil-seed cakes.

Manufacture of plastics from coffee beans.

Experiments on artificial wool from seed cakes.

Manufacture of barium chloride.

Manufacture of aluminium stearate.

Manufacture of leather from fish skin.

Development of healds varnish.

Development of the use of micaceous iron ore as paint pigment.

Manufacture of water-proof packing paper.

Development of substitutes for tin and aluminium foils.

Manufacture of cafein from tea waste.

Application of ultrasonics to industrial problems.

Manufacture of dimethyl aniline.

Development of transport organic gels.

Manufacture of alumina from bauxite.

Development of substitute finishes for binocular and other goods generally finished with fancy leather.

Manufacture of citric acid from citrous fruit.

Water-proofing composition for Indianite.

Manufacture of titanium tetrachloride.

Manufacture of substitutes for picker belts.

Development of vinyl resins.

Manufacture of glossy transparent paper.

Seaming varnish for anti-gas clothing.

Anti-oxidants for mineral waxes.

Pour-point depressants.

Calsolene substitute (wetting agent).

The following list gives the number of schemes being worked under the Board at various centres:—

	Place	No. of Schemes
1.	Aligarh	1
2.	Allahabad	1
3.	Bahjoi	1
4.	Bangalore	12
5.	Baroda	1
6.	Benares	2
7.	Bhagalpur	1
8.	Bombay	9
9.	Calcutta	17
10.	Delhi	6
11.	Hyderabad	1
12.	Lahore	3
13.	Howrah	1
14.	Madras	2
15.	Patna	1

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SCIENCE AND INTERNATIONAL POLITICS

BY modern use, science has come to signify natural philosophy, or verifiable knowledge acquired by observation and experiment. When its field of work is thus defined, there is an impermeable membrane between science and politics. The partition is dissolved when science—the domain of reason—is defined as systematic and formulated knowledge in all fields of human understanding—natural, moral, social and political. At all stages of civilization, these factors have determined the conditions of human life in varying degrees; and in modern times scientific knowledge has been the chief element in the constitution of man's outlook and the greatest power for social and political action.

As science, using the word in the sense now generally understood, is kept apart from politics, it has little influence upon the uses to which this power is applied, whether for good or evil. In general, this influence is not given effective attention in political and social philosophies; and the attitude towards it to-day is much the same as that of Plato towards the results of observational and practical inquiry represented by the Ionian school, upon the principles of which physical science may be said to be founded. In Platonic politics, the State decided what was good for the peoples to know and accept, and the purpose of legislaton was to ensure the stability of a society of rulers and slaves. The spirit of political Platonism still prevails, even though modern science and technology have placed a score of mechanical slaves at the disposal of every citizen in a modern State.

In the understanding of this increased

power, and in action based upon it, political leaders can scarcely be said to take adequate account of the changing conditions of life due to applications of new scientific knowledge, either in the present or for the future. They are in charge of the forces of science, and upon them is the responsibility of seeing that these are used effectively for the progressive welfare of the community. In this relation to politics, the functions of science may be compared with those of an intelligence department which possesses knowledge of the equipment available everywhere for social or political development, but has no influence upon action derivable from it.

In a democratic State, the uses made of science, like those provided for defence or attack on land, sea, and air, are decided by leaders elected by representatives of the people. If these representatives rarely include men distinguished for their contributions to useful knowledge, it is because such original investigators find the air of the research laboratory more congenial and productive than the turbulent atmosphere of politics. In the discussion of any subject, the value of the views expressed depends upon the first-hand knowledge possessed of it. This is as true of politics as it is of science, though in these two fields rhetoric and fact differ in their influence. As the forces of science are in action along the whole front of advancing civilization, it is essential that their strength and their disposition should be given full consideration in all social and political campaigns. Their leaders have a right and a responsibility to their colleagues as well as to other fellow-citizens to share in the preparation of schemes of operation in which their forces are used. When they enter the field of politics, they possess at least as much general knowledge of the problems involved as is required of representatives of other interests, whether industrial, commercial and financial, or of the armed forces. Their views can have no special authority outside the scientific field to which they have devoted particular attention; but they may justly claim to have been trained to face facts before arriving at judgments; and the value of their public service depends upon their competence to transfer this faculty to the consideration of social and political problems.

One reason why few men of science care to take an active part in politics, is that they do not feel able to effect such a transfer of their trained habits of thought. Birth, social surroundings and feeling largely determine the side taken in national politics, but all these have little to do with the making of scientific students and discoverers. It is only by applying to political problems the principles of independent inquiry and impartial judgment demanded of investigators in all branches of natural knowledge, that politics can become a science and scientific workers as such can contribute to its advancement. Without this spirit and purpose science and politics are best placed in different categories.

There is, however, a vast difference between party politics of a national kind and international politics in which the world is the unit and all men are citizens of it, having rights and duties to be wisely adjusted with the object of ensuring progressive development everywhere. This is the field into which the international spirit of science can enter without being regarded as

an intruder or becoming involved in controversial national politics. The world is the possession of man and his endeavour should be to see that its resources, with the powers provided by science, are used for effective development. National boundaries have little relationship to the distribution of natural resources, and less to the needs of modern life. All communities can share in the achievements of scientific discovery and invention, and none can establish an exclusive right to the use of them. Radio communication and aviation have made it impossible for any one nation, or group of nations, to isolate itself from the others, whether near or far. There will be no need for any civilized community to strive for self-sufficiency in a single region, or within a political sphere of influence, when these world powers become agents of international politics. The way may be far to go before national interests will acquire an international outlook, yet the tendency of political groups to become larger gives promise of further expansion into a commonwealth of the chief free peoples of the world.

Such a commonwealth can be secured only by consent, and in it there will be no place for the mastery by force of one race or nation over another. No new world order can have stability unless each nation is free to follow its own lines of cultural development, and does not seek to deprive others of the same liberty. There can be patriotism without arrogance and unity without aggressive imperialism. What is wanted now is not pride of power to make one nation submit to the will of another, and the exercise of it to secure mastery of the world, but pride in a union upon the strength and structure of which each nation depends for freedom and security.

It is only with such a co-operative alliance in mind that the services of science can be used to shape the course of international politics. Knowledge of natural objects and phenomena—their properties, occurrence and range—is not confined to political regions, either in extent or in the use of it. This knowledge is free to the world, and is the foundation upon which the structure of modern civilization is based. It is continually revealing new sources of supply of materials and power to expand this structure as well as to adorn it. Applied science has provided the means of making the world's abundance available to all peoples. The world is, indeed, self-sufficient to supply the needs of all mankind, and the aim of international politics should be to see that the supply is adjusted according to the need for the use of it.

In the fourth clause of the Atlantic Charter, Mr. Roosevelt and Mr. Churchill expressed the intention of the United States and the British Commonwealth to adopt this principle in a unified political policy. The clause declares that "they will endeavour, with due respect for their existing obligations, to further enjoyment by all States, great or small, victor or vanquished, of access, on equal terms, to the trade and to the raw materials of the world which are needed for their economic prosperity".

This Anglo-American declaration, with the power of two great democracies to implement it, gives an impressive outlook to a new world order. No federation of European States alone could make such a declaration of the effective value represented by the unification of purpose of the British

and American Commonwealths. When the principle of freedom of access to the raw materials of the world is conceded by the chief nations of the world, the problems of international politics will be greatly simplified and science will become the chief factor in their solution.

What exists in the world, and what uses can be made of it, are discovered by scientific inquiry and its application. What action is taken upon the knowledge of power thus gained depends upon communities and their governments. Knowledge of natural forces and resources gives no control over them but only an understanding of cause and effect available for human service. Science as such is concerned with the advancement of natural knowledge, and its standards of value are neither ethical nor political. Scientists, therefore, make no special claim to express opinions upon political matters, except in so far as their pursuits affect the welfare of the community, and its repercussions with them. When, however, they give close attention to subjects outside the particular fields they have made their own, their reactions are at least as worthy of consideration as those of other enfranchised citizens.

The view that the sole function of scientists is to study and discover natural facts and principles without regard to the social implications of the knowledge gained can no longer be maintained. It is now widely acknowledged that science cannot be divorced from ethics or rightly absolve itself from the human responsibilities in the use of its powers in economic or political planning. Scientists neglect their duty if they continue to retain the monasterial habits which society commonly assigns to them and are content to remain isolated from the structure of civilization built up from materials provided by them. It is their obligation as citizens to assist in the establishment of a rational and harmonious social order out of the welter of human conflict into which the world has been thrown because the powers they have released have not been rightly used in the services of mankind as a whole.

To suggest that the world is a single unit in which all men have certain fundamental rights to live and work, each according to his capacity and needs, may not be practical politics—national or international—yet these are the basic factors in the world's equation. Science and ethics should be able to agree as to the rights of all men to a place on this earth of ours and their duties to the community. Until international politics mean something more than a survey of national claims and actions, with no scientific or ethical principles upon which to arbitrate, expediency and not righteousness, must continue to determine its judgments.

Before any worthy world order can be established, the fundamental rights of men and communities must be defined and acknowledged by the democracies which promote it. The Anglo-American Charter represents the beginning of the infusion of this spirit into the working of the world affairs. The outlook of international politics is vastly extended by this Charter, and an instrument has been constructed which gives new meanings to the dimensions of time and space on a changing world. It recognises by implication that the goal of a world commonwealth can be brought into sight and gives hope that the promise of a dream is not beyond fulfilment.

It was in this spirit that a Declaration of the Rights of Man was drafted a year ago and submitted to public discussion. Lord Sankey was the chairman of the committee which prepared this statement of rightful human claims and obligations, and Mr. Wells was the originator of it. The opening paragraphs of the introduction to the Declaration may be appropriately reproduced here because they state world conditions differing from those with which international politics have hitherto had to deal. The paragraphs read as follows:—

> "Within the space of little more than a hundred years there has been a complete revolution in the material conditions of human life. Invention and discovery have so changed the place and nature of communications round and about the earth that the distances which formerly kept the states and nations of mankind apart have now been practically abolished. At the same time there has been so gigantic an increase of mechanical power, and such a release of human energy, that man's ability either to co-operate with or to injure and oppress one another, and to consume, develop or waste the bounty of Nature has been exaggerated beyond all comparison with former times. This process of change has mounted swiftly and steadily in the past third of a century, and is now approaching a climax."
>
> "It becomes imperative to adjust man's life and institutions to the increasing dangers and opportunities of these new circumstances. He is being forced to organise co-operation among the medley of separate sovereign States which has hitherto served his political ends. At the same time, he finds it necessary to rescue his economic life from devastation by the immensely enhanced growth of profit-seeking business and finance. Political, economic and social collectivisation is being forced upon him. He responds to these new conditions blindly and with a great wastage of happiness and well-being."

The object of the Declaration was to assemble and proclaim fundamental and inalienable rights of man as a species living upon the planet Earth, and with powers of conquest over agencies—natural or social—which obstruct his advancement. Science and the humanities can meet on common ground in an endeavour to make a Charter of this kind represent elements which enter into human reactions and should be regarded almost as commandments for the guidance of international policies. When agreement has been reached upon the essential human needs and rights declared in such a Charter, a very promising nucleus will have been created upon which scientific and ethical principles can crystallize. Without a foundation of this kind, conciliation of conflicting interests, and political expediency, will determine the influence and actions of leagues, unions, councils and courts, and there will be no fixed star by which to shape the courses of ships in the stormy seas of international politics.

The Declaration of Lord Sankey's Committee was concerned mainly with the rights and duties of man in relation to the community in which he lives, whatever his position and wherever he may have his being. It comprises eleven clauses expressing these rights and obligations, the first of which reads:—

> "Every man is a joint inheritor of all the natural resources and of the powers, inventions, and possibilities accumulated by our forerunners. He is entitled, within the measure of these resources and without distinction of race, colour or professed beliefs or opinions, to the nourishment covering the medical care needed to realize his full possibilities of physical and mental development from birth to death."

Among other principles expressed in the Declaration as applying to all men, and

therefore to be borne in mind in deliberations affecting the world community are:—

> "It is the duty of every man, not only to respect, but also to uphold and to advance the rights of all other men throughout the world."
>
> "Every man has a right to the utmost freedom of expression, discussion, association and worship."
>
> "The fount of legislation in a free world is the whole people, and since life flows on constantly to new citizens, no generation can, in whole or in part, surrender or delegate this legislative power, inalienably inherent in mankind."

Since the outbreak of the conflict in which all peoples of the world are now directly or indirectly involved, many declarations have been made of principles expressing the needs and aims of all men. They all have much in common, and from them it should be possible to construct fixed standards in which the rights of nations are given international values and the welfare of the whole community of mankind is the concern of international politics. However far distant we may be from the effective application of such basic principles, conditions of life to-day demand the formulation, by common consent, of a charter in which all communities will have world rights, relationships, and responsibilities. There can be no unified political, economic and social order unless schemes of reconstruction are conceived in this spirit, with full knowledge of the primitive instincts of man and the lag between them and the powers which science have given him.

The three chief principles of inter-State intercourse, on which international law is based, are said with authority to be:—

(1) Recognition of each other's existence and integrity as States.

(2) Recognition of each other's independence.

(3) Recognition of equality, one with another, of all independent States.

International law may narrate these principles, but international politics have made a mockery of them. A bewildered world finds itself deprived of all these "recognitions", and seeks new fundamental truths to satisfy its outlook. The so-called laws of Nature are only generalisations which have to be revised when cases not covered by them are brought before the court of science. International politics has to adopt a similar attitude towards the evidence presented to it, and international statutes should not be limited to the relationships of one sovereign State to another, but of every State to all others.

In the realm of the humanities, as in that of the natural sciences, the closer the approach of a principle to fundamental truth, the longer will it survive. All peoples of the world have certain attributes in common, and all high religions, teach the observance of certain ethical principles. When these principles have been collated and analysed, a sound basis will be secured for the constitution and judgments of a court of international politics, and the goal of world unity will come into view. Science can usefully combine with politics to attain this end.—SIR RICHARD GREGORY, BT., F.R.S.

[*From an address given at a meeting at Chatham House on Tuesday, February 3rd,* 1942.]

HEAVY CHEMICAL INDUSTRIES IN INDIA*

BY
S. G. SASTRY
(Director of Industries and Commerce, Director of Sandal Oil Factory, Government of Mysore)

YET, another Committee, this time of an exploratory character, is all the help which those who are interested in the development of heavy chemical industries in India have received from the Government of India.

The first Great War of 1914–18 revealed to everybody interested in the subject the utterly backward state of chemical industries in India. In fact there were no chemical industries worth the name throughout the length and breadth of this sub-continent. A factory at Ranipet in South India, one in Bombay and one at Cawnpore—all three owned by British interests—and another small one at Calcutta owned by an Indian firm were manufacturing small quantities of sulphuric acid and some common sulphates. These constituted the sum and substance of achievements in India at that time in the field of chemical industries. To rectify the industrial deficiencies of India, the Indian Munition Board was constituted with a geologist at its head. The Board produced a handbook called the Indian Munitions Handbook, which was published in 1917. A few items of meagre statistics that were available were reproduced. Much was said about the possibilities of heavy chemical industries in India by Professors with academic distinctions. Beyond affording some head lines for the daily press, to focus the attention of the public about the industrial deficiencies in India, to wit, in the field of chemical industries, no steps were taken to actually start new factories in India to produce the chemicals required. After a great deal of agitation, the Indian Industries Commission was appointed and produced a bulky report which was acclaimed in the press as solving all the difficulties in India in the field of industrial development. One of its main recommendations was the appointment of Directors of Industries and Commerce all over India. With characteristic alacrity and promptitude these Departments were created. The achievements of these Departments of Industries all over India are well known to be detailed here. The claims of heavy chemical industries were unheeded. Probably there was good reason for this. During the first post-war period, chemicals poured into India from all the belligerent countries even including Japan at cheap rates and whenever any industrialist thought of starting a chemical industry, the ever-present bogie of competition from abroad unnerved him and deterred him from taking even reasonable chances and risks. The dearth of qualified industrial chemists and technologists added to the difficulty. Indian capitalists had at every stage to depend on foreign experts and advice. The third difficulty was the lack of competent engineering firms who could undertake to manufacture the requisite machinery and equipment as per standard designs. The initial cost of equipment to be obtained from abroad was so high that interest and depreciation charges would impose a heavy strain on the cost of production. The lack of trained routine operatives was another difficulty. In spite of repeated requests by the members in the Legislative Assemblies and regular agitation in the public press, the purchasing Department of Government of India did not insist upon training being given to Indians in factories which regularly received handsome and lucrative patronage. Indian chemists and engineers found it more and more difficult to get any kind of training in British factories. The same was the experience in other continental countries and America. Indians were declined admission to factories even as visitors. The position became intolerable and comments in the public press became insistent. Half a dozen or so of the Indian firms who were struggling to maintain the existing heavy chemical industries in India were threatened with extinction due to foreign competition—in this case mainly from England. The result was the Government of India referred the question of protection to heavy chemical industries in India to the Tariff Board. As usual after wandering all over India, the members of the Tariff Board

* The views expressed in this article do not represent those of the Department of Industries and Commerce, Mysore.

produced a report in 1930. This report continues to be an ornament on the book shelves of libraries all over India. The Government of India did not take any steps which could have afforded even the slightest relief to Indian manufacturers.

The unique example of the difficulties enumerated above faced the Dhrangadhra State in Kathiawar where it was proposed to manufacture soda ash. Undaunted by the difficulties enumerated above, nearly a crore of rupees was poured into this industry, impoverishing the resources of the small State to no inconsiderable extent and at that stage the only thing that could have saved the industry was "Protection" and this was not granted.

Even though it does not strictly pertain to the subject-matter of this article, about the same time, on account of continued agitation in the press, the Drug Enquiry Committee was appointed which produced a valuable report on which partial action was taken and legislative measures were introduced ten years later. The heavy chemical industry did not receive even this amount of recognition. Another great world war showed the pitiable condition of India in the field of heavy chemical industries. The Government of India have appointed an Exploratory Committee!

Convention requires that the term heavy chemical industries should include only the common mineral acids, soda ash, caustic soda and other alkali products together with a few heavy sulphates. Whatever may have been the justification in the past for restricting the use of the term to refer to only these products, the term now-a-days connotes other industries also. Many of the industries which in turn use these basic chemicals also come under the category of heavy chemical industries like distillation of coal tar and production of certain derivatives; manufacture of glass, paper and soap; manufacture of rayon; manufacture of industrial solvents by bio-chemical processes; the fixation of nitrogen with all the ramifications of synthetic ammonia industry; electro-chemical industries like the manufacture of aluminium, calcium carbide and their derived products. Last of all, but probably the most important in the series in the matter of national self-sufficiency comes the manufacture of modern explosives. The list may be added to. Small beginnings in some of these industries have already been made and it is hoped that in years to come these will be afforded adequate protection for expansion and development. The weakest part in this programme is the practical absence of the manufacture of chemicals or chemical products required by the Defence Department of Government of India. One or two Government-controlled factories manufacture small quantities of explosives but as compared with the national demands it is a drop in the ocean. There is an enormous field for expansion of this industry which in turn will give an impetus to the manufacture of the necessary heavy chemicals in practically every branch. It is of course stated that any Tom, Dick and Harry cannot be entrusted with the manufacture of explosives. But under suitable secrecy and protection private Indian capitalists should be encouraged to undertake these manufactures. The necessary corollary of the development of chemical industries required by Defence Department is the development of engineering industries which are equally necessary. Other competent leaders in India are taking adequate steps to focus the public attention to these problems and they have also brought the matter to the notice of the Government of India.

A handicap in India, at all events in South India, for the development of heavy chemical industries is the lack of cheap coal and also the lack of sulphur. Abundant and sufficiently dependable supplies of pure lime is another drawback. Even though phosphates are found in Trichinopoly District the grade is poor. Even though extensive deposits of bauxite are available in South India, they are not pure enough for the manufacture of aluminium unless preceded by costly purification processes. Many of the important mineral raw materials will have to be imported from abroad. This may not deter us since every advanced country is obtaining raw materials from great distances. Since India does not own a sufficiently big fleet of merchantmen receiving handsome private subsidies from Government, the cost of minerals and raw materials brought to India from abroad may be heavier on account of heavier freight charges. As mentioned earlier in this article, for some time to come, we may have to import special equipment from abroad at high prices. With all these drawbacks and difficulties, it is still possible to start a

number of factories specialising in the manufacture of heavy chemicals in South India. Regarding the electric power it is simply a question of Government making up their minds to give power at not more than Rs. 50 to Rs. 60 per Kilowatt year even though they may be able to obtain a higher revenue by selling electricity to factories where no electro-chemical process is involved.

The situation is one full of anxiety and also hope. The anxiety is due to difficulties enumerated above. The hope is centred in another hope, *viz.*, that at no distant future there is bound to be a national Government with national outlook which will necessarily look to national self-sufficiency from the point of view of national existence and national defence.

RADIO FADE-OUTS IN FEBRUARY AND MARCH, 1942

BY

K. VENKATARAMAN

(*Research Department, All-India Radio*)

RADIO fade-outs of the Dellinger type were experienced on a number of occasions during the period 21st February to 23rd March 1942. The times and dates of occurrence of the fade-outs are given below. The particulars given are based on the observations made at the A.I.R. Receiving Centres situated at various places in India:—

Date	Observing Station	Time of commencement of fade-out I.S.T.	Time when revival to normal conditions commenced I.S.T.	Time when conditions became normal I.S.T.	Remarks as to intensity of fade-out, etc.
21-2-1942	Delhi	19·10	19·25	20·00–22·00	On Western stations only (severe)
,,	Trichinopoly	18·55	19·40	..	do
28-2-1942	Delhi	17·30	18·15	20·00–22·00	Complete fade-out of all stations. Even medium wave stations became poor
,,	Bombay	17·30	17·51	20·00; almost back to normal	do
,,	Calcutta	17·30	17·40	..	do
,,	Madras	17·32	17·58	..	do
,,	Trichinopoly	17·30	17·45	18·15; Indian stations normal. Western stations normal only at 22·00	do
,,	Lucknow	17·30	17·55	do	do
3-3-1942	Delhi	17·00	17·10	18·00	Severe fade-out
,,	Bombay	16·55	17·00	..	Partial fade-out
,,	Calcutta	about 16·30	..	..	Partial fade-out
,,	Madras	16·50	17·15	..	Partial fade-out
4-3-1942	Bombay	12·12	12·23	13·00	Severe fade-out
,,	Calcutta	12·05	12·23	..	do
,,	Trichinopoly	12·07	12·20	..	do
,,	Lucknow	about 12·15	..	..	..
7-3-1942	Delhi	10·30	11·20	13·00	Severe fade-out
,,	Calcutta	11·00	12·20	..	do
,,	Madras	about 11·30	12·00	..	..
,,	Trichinopoly	11·30	12·00	..	Severe fade-out
,,	Lucknow	Earlier than 12·00	about 12·00	13·00	Observations made only after the fade-out started
23-3-1942	Delhi	08·10	..	..	Partial fade-out. Eastern stations affected

The differences in the times given by the various stations for the commencement of the fade-outs appear mainly to be due to the sudden and unexpected nature of the phenomenon. The times when conditions returned to normal are very approximate in view of the varying duration of the fade-outs on different frequencies and on different transmitting stations.

While it is not possible to give in detail, the large quantity of observational material that has been collected by the various A.I.R. stations during these fade-out periods, it can be said that, in general, the observations conform with the published characteristics of the Dellinger type of fade-out.[1] It may be mentioned here in particular that during the fade-out on the evening of the 28th February 1942, the signal strength of medium wave stations (550 kc./s. to 1500 kc./s.) also decreased very considerably. This fact is in support of similar observations made by the National Bureau of Standards of America.[2]

Pulse observations made with a multi-frequency pulse generator installed at the main receiving centre at Todapur near Delhi, show that up to the commencement of the fade-outs normal reflections were obtained in the usual manner. During the periods of intense fade-out, however, no trace of any reflections could be observed throughout the continuous range of frequencies tried, namely, 4 to 13 Mc./s. The measured critical frequency of the F_2 layer before and after the fade-outs had not altered to any extent other than what is to be expected from the passage of time. The minimum virtual heights of the F_2 layer also had not undergone any appreciable change.

It is interesting to note that such radio fade-outs, so far as observations made in India since 1939 indicate, have been found to occur mostly round about the equinoctial period, *i.e.*, March and September and sometimes in the last week of February and in the first week of April. The dates on which these fade-outs have been observed by A.I.R. stations since 1939 are given below in support of the above statement:—

Date	Time of commencement I.S.T.	Remarks
29th April 1939	13·00 Hours	Complete fade-out
14th Sept. 1939	12·00 ,,	Complete fade-out
25th ,, 1939	13·30 ,,	Partial fade-out
21st March 1940	08·48 ,,	Complete fade-out
23rd ,, 1940	16·50 ,,	Complete fade-out
30th ,, 1940	11·30 ,,	Partial fade-out
3rd ,, 1941	14·00 ,,	Complete fade-out (severe magnetic storm on 1st March 1941)
17th Sept. 1941	13·59 ,,	Complete fade-out
18th ,, 1941	08·00 ,,	Complete fade-out (severe magnetic storm on 17th and 18th September 1941)
21st Feb. 1942	18·55 ,,	Severe on Western stations only
28th ,, 1942	17·30 ,,	Severe
3rd March 1942	16·55 ,,	Severe
4th ,, 1942	12·07 ,,	Severe
7th ,, 1942	about 10·30 hours	Severe
23rd ,, 1942	08·10 hours	Partial

It will be seen that excepting for the first mentioned fade-out on 29th April 1939, all the other observed fade-outs in India since 1939 have occurred during the equinoctial period.

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[1] Dellinger, *P.I.R.E.*, October 1937, pp. 1253-1294.

[2] National Bureau of Standards (*P.I.R.E.*, October 1940, p. 486).

LETTERS TO THE EDITOR

THIAZOLE DERIVATIVES OF SULPHANILAMIDE IN MONKEY MALARIA

Certain sulphonamides like sulphanilamide, sulphapyridine and sulphathiazole have been shown to possess a curative property against experimental malarial infections in monkeys (See Dikshit and Ganapathi).[1] The author has tried two new thiazole derivatives of sulphanilamide (i) 2-N[1]-sulphanilamido-5-ethylthiazole and (ii) N[1]-methyl-sulphathiazole in several infections, bacterial and protozoal, including malarial infection in monkeys. The present note is concerned only about the malarial infection. The drugs were prepared by Ganapathi *et al.*[2] in the Chemotherapy Department of the Haffkine Institute and supplied by that department.

Rhesus monkeys infected with *Plasmodium Knowlesi* were used for the purpose. When the infection had reached a moderate degree (about 10 parasites per 10,000 R.B.Cs.) the drugs were administered orally by a stomach tube. The dose administered was 1 gm. twice a day for 3 consecutive days. It was found that after administration of these drugs the parasites disappeared completely from the peripheral blood in 4 days. It was further observed that there was no relapse in the monkeys treated with these drugs while controls similarly treated with atebrine showed a relapse. The question of a radical cure was therefore investigated in the case of animals treated with 2-N[1]-sulphanilamido-5-ethylthiazole. It was found that the blood of animals treated with this drug was not infective to normal animals 20 days after the disappearance of the parasites from the peripheral blood and the animals so treated were as susceptible to fresh infection as normal animals. It was therefore concluded that 2-N[1]-sulphanilamido-5-ethylthiazole produces a radical cure in Rhesus monkeys infected with *P. knowlesi.* Cure of *knowlesi* infection in monkeys does not necessarily mean that the drug will be effective in human malaria also and investigations on this point along with the pharmacological investigations are being undertaken.

B. V. Patel.

Department of Pharmacology,
Haffkine Institute,
Parel, Bombay,
May 5, 1942.

[1] Dikshit, B. B., and Ganapathi, K., *J. Mal. Inst. Ind.* 1940, **3**, 525.

[2] Ganapathi, K., Shirsat, M. V., and Deliwala, C. V., *Proc. Ind. Acad. Sci.*, 1941, **14A**, 630.

CURRENT DENSITY AT THE CATHODE OF A GLOW DISCHARGE THROUGH GASES

A METHOD, which consists in rotating a fine hole bored in a cylinder closely fitting into the cathode, has been devised for determining the current density at different points of the electrode. This method is free from the objections which usually accompany the investigations with a "split cathode". The experiments were carried out with plane parallel circular electrodes over a pressure range of 0·33 – 0·02 mm. Hg, voltage range of 365–2990 volts and a current range of 0·25 – 9·5 m. amps.

It has been found that under all conditions of the discharge examined, there is a certain area of the cathode, always the central portion of it, over which the current density is uniform. This area, though mainly dependent on the pressure, shows a slight tendency to decrease with increase of voltage and current at a constant pressure. At low pressures the current density falls off rapidly towards the edges beyond this area and in most cases there is no current at all on the outermost zone of the cathode. The area of the inactive portion of the cathode is also found to be a function of the discharge pressure. At high pressures the current density is uniform over almost the entire surface of the cathode. Figs. 1 and 2 show the current density at the cathode at low and high discharge pressures respectively.

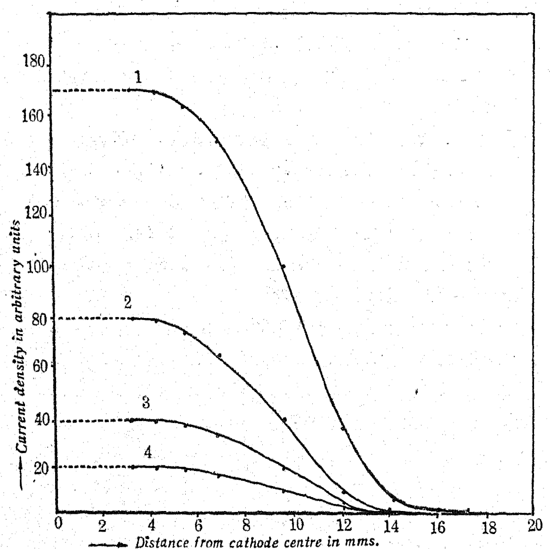


FIG. 1

Gas = Air
Discharge pressure = $1 \cdot 83 \times 10^{-2}$ mm. Hg.
Curve 1 Discharge Volts = 2990
,, Current = 1·75—1·70 m.a.
,, 2 Discharge Volts = 2215
,, Current = 1·0 m.a.
,, 3 Discharge Volts = 1775
,, Current = 0·55 m.a.
,, 4 Discharge Volts = 1250
,, Current = 0·25 m.a.

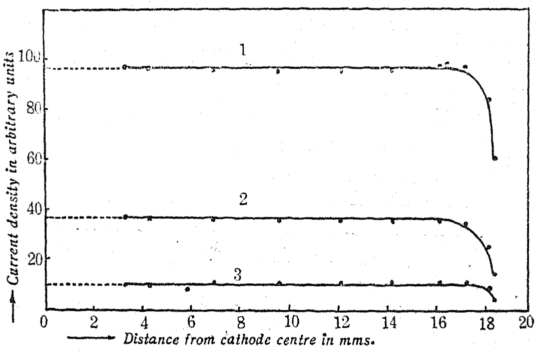


FIG. 2

Gas = Air
Discharge pressure = $1 \cdot 43 \times 10^{-1}$ mm. Hg.
Curve 1 Discharge Volts = 620
,, Current = 8·0 m.a.
,, 2 Discharge Volts = 500
,, Current = 3·3 m.a.
,, 3 Discharge Volts = 420
,, Current = 1·6 m.a.

It is also observed that the Aston's relation, $V = E + \frac{F\sqrt{C}}{P}$, derived from experiments performed at much higher pressures than in the present case, holds good at low pressures as well, where the discharge is strongly "abnormal" and the cathode is not fully covered with the discharge. Fig. 3 shows a relation between V and C, the discharge voltage and current density respectively.

Experiments were also performed with a cathode consisting of several annular rings. The current density over any ring was always found to be greater than over its neighbour towards the edge of the cathode. These observations were confined to comparatively low pressures only, as at higher values the discharge strikes at the back of the rings.

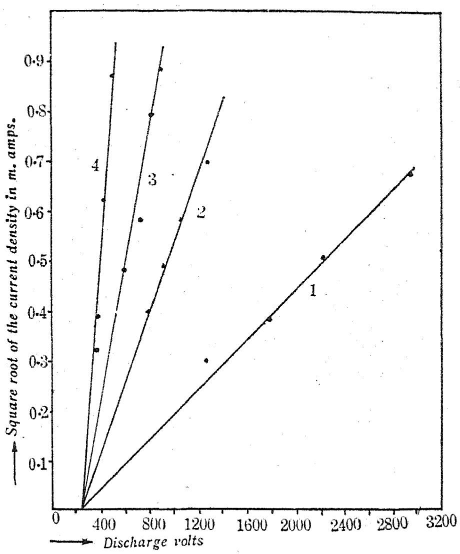


FIG. 3

Gas = Air

Curve 1	Pressure	$= 1 \cdot 83 \times 10^{-2}$ mm. Hg.
,, 2	,,	$= 5 \cdot 07 \times 10^{-2}$,,
,, 3	,,	$= 9 \cdot 24 \times 10^{-2}$,,
,, 4	,,	$= 2 \cdot 49 \times 10^{-1}$,,

Investigations with a cathode perforated with fine holes of equal size at different points were not found satisfactory to give the average current density at the cathode.

Details of the experiments will be published elsewhere.

RAFI MOHAMMED CHAUDHURI.
MOHD. ABDUL BAAQUI.
Department of Physics,
Aligarh,
Muslim University,
April 21, 1942.

VITAMIN D AND OTHER PRODUCTS OF METABOLISM FROM YEAST

AN examination of yeast deposited during the alcoholic fermentation of molasses revealed the presence in it of substances which may indicate the mechanism of its growth and action.

An alcoholic extract of the yeast yielded a light green 'oil' with a characteristic yeast odour. The liquid has a specific gravity, 0·95 to 1·1, refractive index 30° C. = 1·475, congeals at − 17° C. A small quantity of a red oil collecting below the greenish oil, has sp. gr. 30° C. = ·952, $n_D^{30} = 1 \cdot 494$ and deposits crystals which recrystallised from acetone melt at 130°–140° C. From the supernatant greenish oil are deposited crystals with a m.p. = 155°–160° C.

The yeast oil is separated into an acetone soluble green liquid of $d = 1 \cdot 07$, $n_D = 1 \cdot 476$ and an acetone-insoluble brown liquid of $d = 1 \cdot 18$ and $n_D = 1 \cdot 468$. Three or more water-soluble acids of high molecular weight, with a pleasant smell are found in the acetone soluble liquid. A pale yellow, unsaturated acid, $n_D = 1 \cdot 439$, soluble in ether, reduces $KMnO_4$ and $AgNO_3$ solutions, decolourises bromine water, its alkaline solution is oxidised and turns black in air; with $FeCl_3$ solution a green blue colour appears and it has a neutralisation equivalent of 135. A second acid, ether soluble, crystallises in rhombic plates or as a cluster of needles seen under the microscope, with a m.p. = 178–180° C. Another acid is a brown liquid, insoluble in ether, soluble in alcohol, $n_D = 1 \cdot 468$, with a neutralisation equivalent of 290. Another black, powdery acid is insoluble in water and ether, soluble in alcohol, its alkaline solution turns dark in air, like that of pyrogallol.

The neutral oil, on saponification, gives rise to an acidic component, a pale yellow liquid, $n_D = 1 \cdot 459$, insoluble in water and separated into an ether-soluble acid $n_D = 1 \cdot 445$ and an ether-insoluble acid, $n_D = 1 \cdot 423$ with a neutralisation equivalent of 274.

From the unsaponifiable and neutral liquid, pale yellow crystals deposit and recrystallised from acetone have a m.p. = 115–120° C. The mother liquor, $n_D = 1 \cdot 499$, has a bright orange-yellow colour and a characteristic pungent smell. The liquid consists largely of ergosterol (Vitamin D) as estimated by spectrographic and gravimetric methods. (Courtesy of Mr. M. Sreenivasaya, Indian Institute of Science, Bangalore.)

Further identification and quantitative determinations are in progress.

Y. K. RAGHUNATHA RAO.
Mysore Sugar Co.,
Mandya,
March 12, 1942.

PRETREATMENT OF COTTON SEED WITH AMMONIUM SULPHATE

PLACEMENT of fertilizers appears to be an important factor governing the response of a crop to fertilizer application.

In the case of cotton, the usual methods of applying Ammonium Sulphate at the time of sowing are (*i*) drilling the seed first and dropping the fertilizer by hand later in the opened out furrows and finally covering them up or (*ii*) drilling the fertilizer with dry seed itself.

A still more convenient method would appear to be to sow the cotton seed coated with Ammonium Sulphate. The coating with Ammonium Sulphate is best done when the seed in a slightly moist state, after treating it with earth and dung paste, is mixed up with dry Ammonium Sulphate. Maximum amount of Ammonium Sulphate that can be coated round the seed depends upon the variety having a big or small size seed and the seed rate used. In the case of V. 434 cotton seed it is estimated that Ammonium Sulphate equivalent to 20 lbs. of Nitrogen can be coated round it, the seed rate being 20 lbs. per acre. The number of seeds per gramme weight is 14·69 in the case of V. 434 cotton.

An experiment was conducted on the Seed and Demonstration Farm, Khandwa (Nimar), during 1941–42. Nitrogen applied was at the rate of 10 lbs. per acre, in the form of Ammonium Sulphate. Mean yield of kapas obtained was as shown in the table below. The experiment was of a randomised block type, with five replications, the plot size being 1/40th of an acre.

Mean yield in lbs.

Yield	Treatment: Coated	Topdressed	Half drilled with dry seed and half top-dressed	Control	Mean	S.E.
1	2	3	4	5	6	7
Per acre	644·0	443·2	456·8	387·2	482·8	31·72
Per cent. of mean	133·8	91·8	94·6	80·2	100·0	6·57
Per cent. of control	166·3	114·5	118·0	100·	—	—

Important observations are:—

(*i*) Application of fertilizer at the time of sowing appears to be better than applying it as a top dressing.

(*ii*) The best way of applying the fertilizer at the time of sowing is to coat it round the seed before sowing. The increase in yield obtained by this method is over 66% above the control, the increase which is not usually obtained even by higher application of over 40 lbs. of nitrogen per acre in the usual manner. Coating with Ammonium Sulphate is best done when the seed, in a slightly moist state after treating it with earth and dung paste, is mixed up with dry Ammonium Sulphate.

(*iii*) The treated plots are earlier to mature and have a better bearing and larger size of bolls; those in which the seed is coated are the earliest to mature.

The results will be discussed in full elsewhere. Further work is in progress.

R. J. KALAMKAR.

Department of Agriculture,
Jubbulpore, C.P.,
April 9, 1942.

METALLOGRAPHY OF INDO-GREEK BRONZE COINS FROM TAXILA

THROUGH a chemical and metallographic analysis and *Diamond Hardness* of the Indo-Greek coins from Taxila, an attempt is being made to reconstruct the system of ancient Indian Coinage and to trace the sources of the metals employed. One of the interesting minor results of these investigations confirms and is confirmed by Prof. Birbal Sahni's conclusions regarding the minting of ancient Indian coins at Rohtak.

In 1936 Prof. Birbal Sahni, F.R.S., discovered a number of coin moulds used by the Yaudheyas[1] (Ca. 100 B.C.) in certain mounds at Kokra Kot in the immediate vicinity of Rohtak (Long.

76° 35′ E, Lat. 28° 54′ N) in the Punjab. This discovery enabled him to reconstruct the technique employed by the Yaudheya mint masters. It is not unlikely that the same technique has been employed in other ancient mints as well.

is a system of polygonal grain boundaries representing crystal grains which constitute the mass of the metal, one finds large grains in the coins of the central moulds. The coins in the top and bottom layers of moulds show

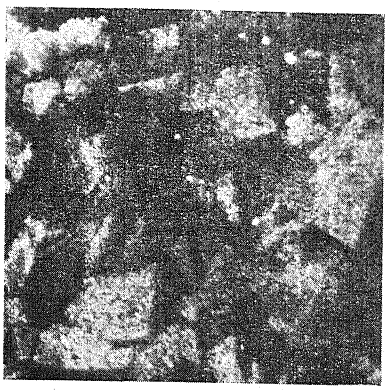


FIG. 1

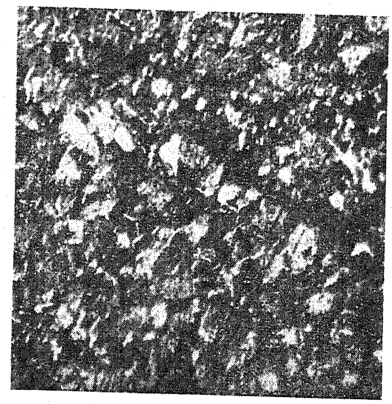


FIG. 2

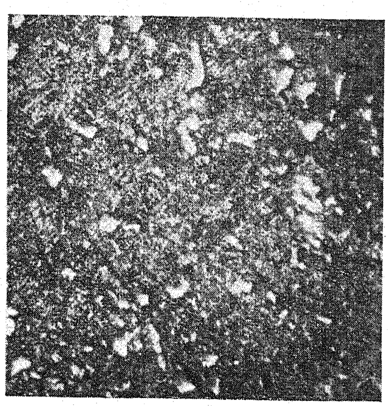


FIG. 3

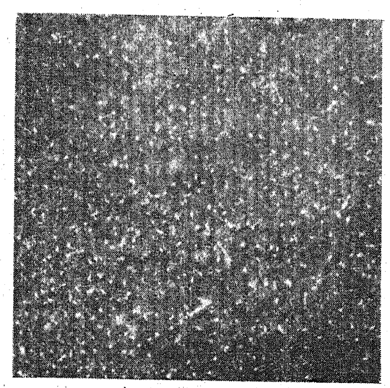


FIG. 4

Figs. 1–4. Etched with acid Ferric chloride. × 100.

Molten alloy is poured into the complex mould system reconstructed by Prof. Sahni in which the moulds are arranged one over the other. If the alloy is allowed to cool of itself through the critical temperature, the central moulds in the system are kept hot by the molten or hot alloy in the top and bottom tiers of moulds. Thus the central moulds cool slowly. On the other hand, the moulds at the bottom and at the top cool more rapidly. Hence the coins in the different layers of moulds must show variations in the metallographic structures. Remembering that the cooled alloy

grains which are structureless and almost amorphous through rapid cooling. In the latter case the molten metal has had no time to crystallise. Between these two extreme limits, there are structures showing different grain sizes and of grains in the making.

The mechanism of minting reconstructed by Prof. Sahni was verified in the case of Indo-Greek bronze coins[2] (Ca 250 B.C.-60 A.D.) from Taxila (Long. 72° 50′, Lat. 33° 40′)—a region not far away from Rhotak. Microphotographs of about 120 coins were taken. The metallographic structures of these coins grouped

themselves under four broad divisions which are illustrated below. Fig. 1 shows large crystals and represents the metallographic structure induced by a slow cooling of the alloy. Fig. 2 shows the structures of a more rapid cooling alloy. The crystals are smaller in size. Further growth has been suppressed as a result of quick cooling. The coins were probably from moulds between the central and the top or bottom tiers of moulds. Fig. 3 shows the structure when the rate of cooling is higher than that for (1) and (2), probably of coins in moulds nearer the top or the bottom tiers than the central ones. There are only a few small crystals in a groundmass of amorphous precipitations. Fig. 4 shows the structure when the cooling is still more rapid, such as of moulds at the top or bottom of the system and consists entirely of precipitation.

Thus the metallographic structures broadly fit in with the reconstruction suggested by Prof. Sahni. These metallographic structures can be explained somewhat differently—at least so far as the Indo-Greek coins are concerned. If the mould containing the molten alloy is covered with earth or such other non-conducting material or if some process of annealing is employed, the rate of cooling will be slow, resulting in large grain size such as is illustrated in Fig. 1. The coins being very thin (2-3 m.m. in thickness), the slow cooling should have been purposely effected. Otherwise the appearance of large grains is inexplicable. On the other hand, if the molten metal is suddenly dipped into a liquid or normalised, the structure shows minute precipitation as in Fig. 4 without any crystalline structure. Between these extreme limits, Figs. 2 and 3 illustrate the structures when the molten metal neither cools so slowly as in (1) nor so rapidly as in (4). Probably air cooling or cooling with a wet mould was employed in such cases.

It is interesting to note that the crystals do not show any twinning or elongation. The absence of such deformation is another clear indication that the Indo-Greek coins have not been die-stamped as modern coins are, but cast in moulds.

S. PARAMASIVAN.

Government Museum,
Madras,
April 8, 1942.

[1] B. Sahni, *Current Science*, 1935-36, 4, 796.

[2] The author is indebted to Rao Bahadur K. N. Dikshit, Director-General of Archæology in India for these coins.

ON THE OCCURRENCE OF PARGASITE IN MYSORE

LAST year was published in the *Mysore University Journal*[1] a comprehensive account of the optical characters of some "Blue amphiboles" in the Mysore State; and from such optical characters, it was deduced that their chemical composition could be expressed as a mixture of the Pargasite, Common Hornblende and Glaucophane molecules. It was also deduced that an increase of Soda and Ferric content, denoted intenser pleochroism and higher birefringence.

One of these Blue ambhiboles, collected among the Ultrabasic rocks of the Mysore District, has been kindly analysed by Mr. M. Sesha Iyengar, and his colleagues, Mr. G. Narayan and Dr. M. R. Aswathanarayana Rao. For comparison are set below analyses of Pargasite and Hornblende.[2]

	Blue Amphibole	Pargasite	Hornblende
SiO_2 ..	46·89	41·26	39·80
Al_2O_3 ..	11·86	11·92	14·28
FeO ..	12·08	9·92	19·02
Fe_2O_3 ..	1·96	4·83	2·56
CaO ..	10·81	11·95	10·73
MgO ..	11·91	13·49	9·10
Na_2O ..	3·05	1·44	1·79
K_2O ..	0·15	2·70	2·85
H_2O ..	0·70	0·52	1·42

The above results show the approximation of the Blue amphibole under study to Pargasite rather than to Hornblende.

A. N. Winchell[3] has opined that the amphiboles, like the pyroxenes, should be regarded not as mixtures of oxides, but as a mixture of silicate molecules, having the general formula $RR'R''_3$, *i.e.*, metasilicates of the type of $MgSio_3$, $FeSiO_3$, H_2SiO_3, $CaMgSi_2O_6$, $CaFeSi_2O_6$, (Na, K) $FeSiO_2O_6$, (Na, K) $AlSi_2O_6$, $AlAlO_3$, $FeFeO_3$.

Recasting the above chemical analysis in terms of these molecules, the Mysore Amphibole has the formula,

$$2CaMgSi_2O_6 \cdot MgSiO_3, (Na, K) AlSi_2O_6 \cdot 2(Fe, H_2)SiO_3 \cdot (Na, K) FeSi_2O_6 \cdot AlAlO_3.$$

The percentage of these molecules occurring in the "Blue amphibole" under study are calculated, and set for comparison with two of Winchell's studies as also with that of a Hornblende:

	Blue Amphibole	Pargasite		Hornblende
		I	II	
$CaMgSi_2O_6$ ..	28·30	47·18	34·61	29·38
$MgSiO_3$ ..	15·09	31·06	17·73	15·13
$FeSiO_3$ ..	29·53	·31	14·03	10·78
H_2SiO_3 ..	11·32	..	..	..
(Na, K) $FeSi_2O_6$	1·89	1·21	·77	..
(Na, K) $AlSi_2O_6$	15·09	..	..	..
$AlAlO_3$ ..	9·43	..	7·50	7·67
$FeFeO_3$ ..	..	..	1·33	7·25
(Na, K) AlO $(F\cdot OH)_2$ ..	..	18·84	11·62	11·21
$CaFeSi_2O_6$.	..	2·25	13·03	19·86
	Mysore	Grenville	Finnland	Mt. Somma

The molecular affinities of the Blue amphibole are with Pargasite rather than with Hornblende. The Mysore Pargasite differs from the Finnland Pargasite, in the fact that the glaucophane molecule replaces the $CaFeSi_2O_6$ molecule in the latter.

This chemical study, therefore,—the location of the glaucophane molecule,—confirms the chemical deductions forecast by optical studies.[4] Such concordance between chemical composition and optical characters is, according to Winchell, a fairly constant feature of amphiboles, which have an alumina tenor of 10 to 15 per cent., and a Ca : Mg + Fe ratio of about 1 : 2. It will be seen in the Mysore Pargasite that the alumina is 9·43 per cent., and the Ca : Mg + Fe ratio is 15Ca : 23Mg + 13Fe, which is roughly about 1 : 2. The optical characters of the Mysore Pargasite are set hereunder, alongside the characters of the Finnland Pargasite.[5]

Pargas. Finnland	*Mysore*
$Z \wedge c = +26°$	$Z \wedge c = +18°$
— ve	— ve
$\gamma - \alpha = \cdot 019$	$\gamma - \alpha = \cdot 021$ (by Berek's Compensator)
$2V = 63°$	$2V = 64°$ (by the Mallard Constant Method)

Pleochroism

X = Greenish-yellow	Yellow
Y = Emerald-green	Greenish-yellow
Z = Greenish-blue	Indigo-blue.

The agreement in optical characters between the Finnland and Mysore Pargasite, is fairly good. The appearance of the glaucophane molecule, in the Mysore Pargasite, gives it an intenser pleochroism.

P. R. J. Naidu.

Department of Geology,
Central College,
Bangalore,
April 15, 1942.

1 *Mysore University Journal*, **1**, Part 18, 159-70.
2 Van Horn, *General and Special Mineralogy*, p. 556.
3 *American Journal of Science*, **8**, 292.
4 *Mysore University Journal*, *Op. cit.*
5 Dana's *Text-Book of Mineralogy*, 4th Edition, p. 575.

CHROMOSOME COUNTS IN THE SUGARCANE AND ITS HYBRIDS

One of the major handicaps associated with cytogenetic studies in the sugarcane is the very large number of chromosomes, particularly in recent seedlings where this number is known to reach as many as 164. One contributory factor to such large numbers is the doubling of chromosomes in one of the parents during megasporogenesis, while a second is the polyploid nature of most cultivated sugarcanes. These large numbers render the countings somewhat uncertain—particularly in the somatic phase—with the result that certain investigators have recorded the number in somewhat vague terms as 106 to 108.

Constant improvement in technique is gradually introducing greater certainty into such counts and it would appear that certain of the previous countings might need revision. A few instances are mentioned here.

Janaki Ammal[1] in her study of different types of *Saccharum spontaneum* found the numbers to be multiples of 8, such as, $2n = 48, 56, 64, 72$

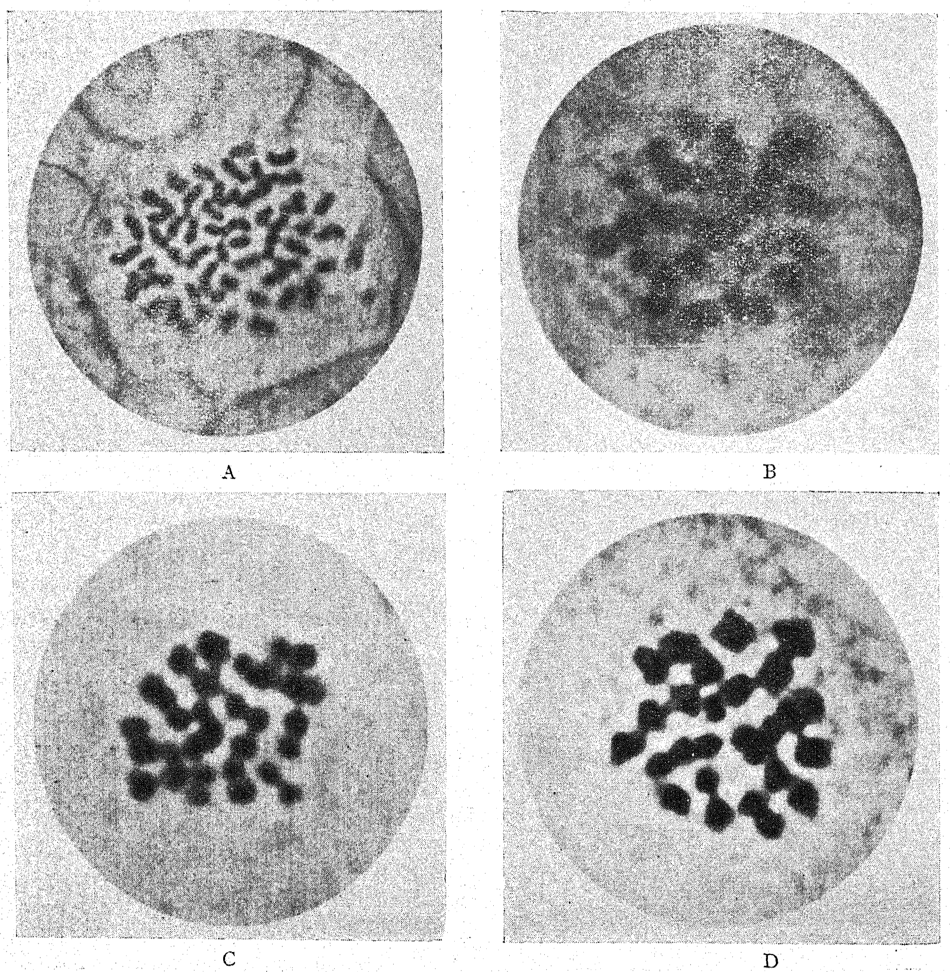
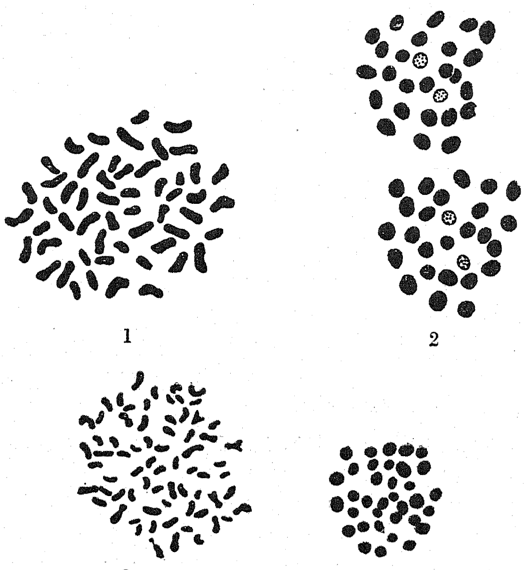


PLATE I

A. Somatic metaphase, *Saccharum spontaneum* (Lahore) × 2,500. $2n = 54$.
B. Polar view of metaphase I of *Saccharum spontaneum* (Bihar) × 3,500. $n = 30$.
C. do. $n = 30 + 1$ I.
D. do. (Dehra Dun) × 3,500. $n = 27$.

and so on. Subsequent work at Coimbatore is showing that one of the types of *Saccharum spontaneum* (the Lahore form) which was reported to contain $2n = 48$, is found to contain $2n = 54$ (Plate I A, Text-Fig. 1). This has been confirmed by the examination of a number of sections. Again, certain of the *Saccharum spontaneum* types obtained from Bihar have



Figs. 1-4 × 2500

1. Somatic metaphase *Saccharum spontaneum* (Lahore) $2n = 54$. (*cf.* Pl. I A)
2. Anaphase 1 (Dehra Dun) $n = 27$ (each group drawn separately).
3. Somatic metaphase *Bambusa arundinacea* $2n = 70$.
4. Metaphase 1 *Bambusa arundinacea* $n = 35$.

recorded varying numbers of chromosomes, such as, $n = 30$ and $n = 30$ plus 1 (univalent) (Plate I B and C). The form from Dehra Dun, which was reported to possess $n = 28$ by Janaki Ammal,[1] is found to possess $n = 27$ (Plate I D). This number has been confirmed by counting the chromosomes in the first division anaphase stage as well (Text-Fig. 2).

Similar discrepancies in counts have also been found in the genus *Bambusa* with which sugarcane has been crossed. *Bambusa arundinacea* has been examined both in mitosis and in meiosis and is found to contain $n = 35$ and $2n = 70$ (Text-Figs. 3 and 4) against $2n = 72$ recorded by other investigators.[2]

It would appear that in the case of sugarcane hybrids numbers alone may not be conclusive with regard to their parentages. Independent breeding tests to determine parental contributions, particularly on the mother side, are needed for indicating parentages with certainty. It is now well known that the number of chromosomes in sugarcane hybrids might either be the sum of the gametic numbers of the parents or the sum of the number in the male gamete *plus* twice the gametic number of the female parent. Recently, there is evidence to indicate that in certain male sterile sugarcanes, like P.O.J. 2725, seedlings may also arise through parthenogenesis, all of which show that mere numbers alone are not sufficient to indicate parentage with certainty.

T. S. Venkatraman.
N. Parthasarathy.

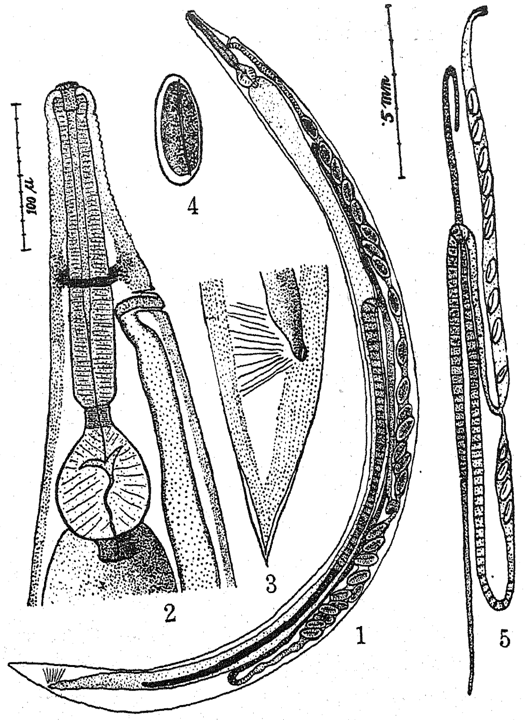
Imperial Sugarcane Station,
Coimbatore,
April 6, 1942.

1 Janaki Ammal, *Ind. J. Agri. Sci.*, 1936, **6**, 1.
2 —, *Nature*, 1938, **141**, 925.
Uchikawa, I., *Imp. Bur. Pl. Genetics*, *Pl. Breed. Abs.*, 1936, **6**, 289.

PROTRELLINA PHYLLODROMI SP.NOV. A NEW NEMATODE PARASITE OF THE COCKROACH *PHYLLODROMIA HUMBERTIANA* SAUSS.

Recently the author had an opportunity of dissecting a few specimens of *Phyllodromia humbertiana* Sauss. Only one of them was found to carry nematode infection, and a single worm was recovered from the rectum of the infected cockroach. On examination it was found that the worm belongs to the family *Thelastmatidæ* Travassos 1929,[1] and to the subfamily *Protrelloidinæ* Chitwood 1932.[2] The worm represents a new species of the nematode genus *Protrellina* Chitwood 1932. The name

Protrellina phyllodromi is proposed for this species.



Protrellina phyllodromi sp. nov.

Fig. 1. Female, entire, lateral view.
2. Female, œsophageal region, lateral view.
3. Female, tail, lateral view.
4. Egg.
5. Female, reproductive organs.

Specific description.—Protrellina:

Male unknown.

Female 2·3 mm. long by 160 μ wide. Cuticle striated only anterior to vulva. First annule 22 μ wide, the following annules have a maximum width of 5 μ; the width of annules regularly decreases till striations are lost. Mouth surrounded by eight labiopapillæ. Buccal cavity cylindrical, 15 μ long by 10 μ wide. Œsophagus 300 μ long, consisting of an anterior corpus 210 μ long by 32 μ in maximum width, an isthmus not distinctly separated from the bulb, and a valvular bulb 65 μ wide. Nerve ring 130 μ from the anterior end of body. Excretory pore immediately in front of the vulva, 150 μ from the anterior end of body. Intestine with a slight anterior cardia. Anus 145 μ from the posterior end of body. Uterus bifurcating at one third of the body length from the posterior end, one branch is directed posteriorly and the other turns and is directed anteriorly; unbranched part of uterus 1·6 mm. long. Ovaries two, anterior ovary directed posteriorly and reflexed anteriorly, posterior ovary directed posteriorly but not reflexed. Eggs elongated elliptical, 75 μ long by 35 μ wide, without a crest, with two lateral grooves.

The species described in this paper resembles *Protrellina galebi,* but differs from the latter in the following characters. In *P. galebi* the adult worms are 5·5 to 7·8 mm. long while in *p. phyllodromi* the length is only about 2·3 mm. In *P. galebi* vulva is situated anterior to middle of œsophagus while in *P. phyllodromi* it is posterior to middle of œsophagus. The arrangement of reproductive organs in the two species is very different. In *P. galebi* the unbranched part of the uterus bifurcates near middle of body and in *P. phyllodromi* it bifurcates at about two-third of the body length from the anterior end. In *P. galebi* both the ovaries are directed anteriorly and are not reflexed while in *P. phyllodromi* both the ovaries are directed posteriorly, and the anterior ovary is reflexed.

Host.—Phyllodromia humbertiana Sauss.

Location.—Intestine (rectum).

Locality.—Aligarh (Northern India).

Type specimen.—Museum of the Zoological Laboratories, Muslim University, Aligarh.

For the purpose of differentiating the species at present included in the genus *Protrellina,* the following key is appended.

Key to the Species of the Genus Protrellina

1. Eggs not bearing cuticular crest .. 2
   Eggs bearing cuticular crest .. 3
2. Adult females about 2·3 mm. long *P. phyllodromi.*
   Adult females 5·5 to 7·8 mm. long *P. galebi.*
3. Eggs bearing cuticular bosses on crest, tail of female constricted *P. manni.*

Eggs apparently without bosses on crest, tail of female not constricted *P. australasiæ*.

4. Vulva near base of œsophagus, œsophagus 633 μ long; eggs 130 to 180 μ long by 70 to 100 μ wide, with cuticular crest *P. künckeli*.

Vulva anterior to and not near base of œsophagus, œsophagus 270 to 380 μ long; eggs 85 to 90 μ long by 36 to 41 μ wide, with cuticular crest *P. aurifluus*.

M. A. Basir.

Department of Zoology,
Muslim University, Aligarh,
April 8, 1942.

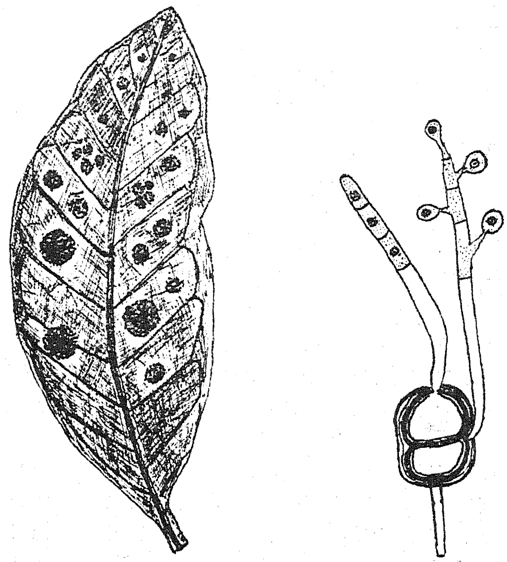
[1] Travassos, L., *Int. Oswaldo Cruz. Suppl.*, 1929, **5**, 15.
[2] Chitwood, B. G., *Zeit. Parasitenk.*, 1933, **5**, 1, 14.

A NEW SPECIES OF PUCCINIA ON *CHOMELIA ASIATICA* O.Kze.

During the course of the studies on some of the rust fungi of Mysore, the writer collected a rust on *Chomelia asiatica* (*Tarenna zeylanica* Gaertn. = *Webera corymbosa* Willd. = *Stylocoryna Webera* W. & A.) which has been found to be a new species of *Puccinia*, and the name *Puccinia Chomeliae* Thirumalachar is proposed.

The fungus attacks the leaves and twigs, forming cushion-like pustules (Fig. 1). Only the telial stage has so far been observed. Telia are subepidermal and soon become naked, the epidermis being cast off as a thin layer. Teliospores measure 35–38·8 × 25–30 μ, and are yellowish-brown, two-celled, pedicellate and slightly or not constricted at the septa (Fig. 2). The wall of the spore is thick, laminate and slightly hygroscopic, measuring 3·5 to 5 μ in thickness. The pedicels are 42–87 μ long.

Teliospores germinate within 24 hours without a resting period. The two cells of the spores each develop promycelia, on which are borne spherical thin-walled sporidia measuring 12 by 7 μ.



1 2

1. Infected leaf *Chomelia asiatica* O. Kze.
2. Germinating teliospore × 400.

The Puccinia on *Chomelia asiatica* shows close resemblance to *Puccinia pentanisiae* Cke. on *Pentanisia mirablis* Harv. (Cooke, 1882), another member of the *Rubiaceæ*. But in the latter rust the pedicels are obliquely attached, whereas in the one on *Chomelia asiatica* these are not oblique. The spore measurements also show variations.

Description of the rust.—Telia hypophyllous, subepidermal, blackish, aparaphysate; teliospores 2-celled, obovate, 35–38·8 by 25–30 μ, slightly or not constricted at septa, germinating without rest period; wall yellowish-brown, 3·5–5 μ thick, laminate, hygroscopic; pedicel hyaline 42–87 μ long. Basidiospores thin-walled, spherical, measuring 12 by 7 μ.

Hab. on leaves and twigs of *Chomelia asiatica* O.Kze., leg. M. J. Thirumalachar, Chamundi Hills, Mysore, 15-7-1941. Type specimen deposited in the Herb. Crypt. Ind. Orient of the Imperial Agricultural Research Institute, New Delhi.

The writer wishes to acknowledge his indebtedness to Dr. B. B. Mundkur, Dr. M. A. Sampathkumaran and Dr. L. N. Rao, for

guidance and encouragement given in the course of this work.

M. J. THIRUMALACHAR.

Department of Botany,
Central College,
Bangalore,
April 14, 1942.

[1] Cooke, M. C., *Exotic Fungi*, *Grevillea*, 1882, **10**, 125.

ON "THE MANUFACTURE OF GLANDULAR PRODUCTS IN INDIA"

PROF. B. B. DEY[1] has drawn pointed attention to the urgent need for increased emphasis on hormone-research in India and towards the possibility of producing almost all the glandular products used in medicine from indigenous raw materials. It is a pleasure to be able to record that considerable progress has already been achieved in this direction, of late. Barring insulin and the sex hormones, *e.g.*, œstrus-producing hormone, corpus luteum hormone and the male hormone, almost all other glandular products commonly used in therapeutics, such as adrenaline, pituitary (posterior lobe) extract, dry thyroid powder, liver extracts, etc., are now being produced largely in and around Calcutta and also partly in Bombay from indigenous raw materials. Many of these are found on careful analysis and standardization, both chemically and pharmacologically, to be of good quality and agreeing with standard requirements. The production is not yet commensurate with the demand but this aspect will not be difficult to attend to gradually, provided sufficient encouragement is forthcoming from the medical profession and the public.

As has been pointed out by Prof. Dey, accurate and unbiassed standardization of every batch of the products manufactured is the key-note of success in such endeavours. Naturally many manufacturing concerns in this country cannot afford to maintain a technical staff and equipment adequate for such responsible work. During the last 3 or 4 years, the Government of India have rendered considerable help in this regard, through the Biochemical Standardization Laboratory, to the manufacturing concerns engaged in the production of these glandular preparations. To give a real fillip to this industry, however, facilities, of a much more comprehensive character than are at present available at the Biochemical Standardization Laboratory, have to be provided.

Excepting the anti-anæmic principle of the liver, almost all glandular products can be biologically assayed fairly accurately on laboratory animals. For satisfactory and reliable data, however, it is necessary, in many instances, to use animals kept under standardized conditions, with regard to temperature, diet, housing, mating, etc. This necessitates a large animal-housing establishment with trained personnel to look after the animals. Unfortunately many medical research institutions in this country have not paid adequate attention to this vital paraphernalia of a biological laboratory. Calcutta, in spite of many facilities for research work, is very poor in this regard. The idea that the climate of Calcutta is not suitable for laboratory animals is untenable, as with more or less similar warm climatic conditions, Bombay (Haffkine Institute) has succeeded in rearing and breeding white mice and white rats in sufficient numbers.

If collaborative effort between chemists, pharmacologists and bacteriologists are encouraged and adequate laboratory facilities are offered, there seems no reason why every type of glandular product of standardized potency could not be made in India from Indian raw materials. Some of these like adrenaline, thyroxine and sex hormones can also be synthesized provided the intermediate chemicals and reagents are brought out into India from Great Britain or America.

B. MUKERJI.

Bio-Chemical Standardisation Lab.,
Govt. of India,
All-India Inst. of Hygiene &
Public Health, Calcutta,
April 13, 1942.

[1] This Journal, 1942, **11**, 110.

REVIEWS

Mineral Metabolism. By Alfred T. Shohl. (Reinhold Publishing Corporation, New York; Chapman & Hall Ltd., London), 1939. Pp. x + 384. Price 30*sh.*

At the commencement of the last decade, scientific investigators in the field of nutrition felt the urge of a new approach to the problem of human nutrition. It was becoming increasingly evident that nutriment meant more than the calories and the "building units" derived from carbohydrates and proteins and that there was something more fundamental which catalysed the entire chain of biochemical reactions, generalised as metabolism. The effect of traces of highly active and specific compounds like vitamines and the function of minerals and other "trace" elements, were unravelled. Interest in these fields, vitamines and minerals, was aroused and during the last fifteen years, there has accumulated a great mass of data regarding the role of minerals in the field of nutrition.

The volume under review represents a praiseworthy and successful attempt at giving a connected and readable account of the various aspects of mineral metabolism. In a series of fourteen chapters, the author has tried to cover this comparatively new field of human nutrition. Particular attention may be invited to the chapters relating to calcium and magnesium, phosphorus, iron, iodine and trace elements, which respectively deal with the function of these minerals. The interrelationships between a few of these elements and some of the vitamines and hormones, calcium and calciferol, calcium and parathyroids, iodine and the thyroids, are discussed in great detail.

Physicians and dieticians will feel particularly grateful to the author for the last chapter on mineral intakes, balances and requirements, which discusses the mineral requirements of the adult man, the pregnant and the lactating woman and the growing infant. The comprehensive and well-documented bibliography appended at the end of each chapter is helpful to those interested in diving deep into the subject. This is a volume which will be welcomed not only by the scientific investigator devoted to researches in the science of animal nutrition but also to physicians, physiologists, pediatricians and dieticians, who are interested in the application of these fundamental results to human welfare.

Biological Aspects of Infectious Diseases. By F. M. Burnet. (The University Press, Cambridge), 1940. Pp. vii + 310. Price 15*sh.*

This is an unusual volume which discusses the problem of infectious diseases of man from the point of view of a biologist. The author is of the opinion that a biological approach to this problem might offer a better means of understanding and controlling diseases which constitute an important aspect of human life.

The five parts which include the twenty-five chapters of the volume, present the varied aspects of the problem—the ecological considerations of the incidence and spread of infection, the evolution of infection and defence, the variety and nature of the infective agents, the nature and significance of immunity, the mechanism of the causation and the control of infectious diseases and the future evolution of infection in relation to man. Some of the important infectious diseases,—diphtheria, influenza, cholera, plague, malaria, yellow fever, etc.,—are discussed against a historical background of their first incidence and their subsequent spread and control.

Under the caption "How infections spread", the author has given an illuminating survey of the modes and mechanisms of the spread of infection under the conditions of modern life. Infections which incriminate the lower part of the digestive tract are spread by the dissemination of fœcal material which might contaminate water, milk, and food in many a direct and indirect way, the finger and the fly constituting the principal agencies in this respect. An efficient sewage disposal, a pure water supply, stringent food laws, supply of hygienic milk and personal cleanliness, have together conspired to conquer many of these diseases. An outbreak of typhoid or an epidemic of infantile diarrhœa, should therefore be looked upon as a civic disgrace. It is a well established fact that typhoid fever and filthy drains go together and the most

elementary precaution that an enlightened municipality should take is to keep drinking water and sewage out of each other's way.

"Droplet infection" or infection by the respiratory route is another mode of spread of disease, and this form of spread is considered to be the most important route by which infections spread among the more advanced communities.

Other forms of spread which are peculiar to the social diseases, and the "unnatural" spread of diseases through bites of insect vectors are discussed in a very interesting manner.

The outlook for the future, as visualised by the author, appears alarming; most of the new diseases which have recently appeared constitute infections of the brain and the spinal cord. The nature of certain rare illnesses which occur, particularly in infants, and which are labelled encephalitis, still remains obscure; another disquieting possibility which the author fears, is the attempt on the part of the belligerents to disseminate infection artificially. The attack through the bacteriological weapons would remain invisible and unknown and death would be delayed for days. How such an insidious weapon is to be combated, is a problem of the future but let us all hope that an unhappy problem with such tragic consequences will never arise.

The volume represents a highly fascinating and stimulating account of the biological aspects of infectious diseases which afflict man and is one which is bound to command the attention of a wide circle of readers.

Practical Solution of Torsional Vibration Problems. Vol. II. By W. Ker Wilson. (Chapman & Hall, Ltd., London), 1941. Second Edition. Pp. xxi + 694. Price 42*sh.*

This is a continuation of the first volume published in 1940 by the same author. The opening chapter (Ch. 7) deals with the determination of stresses due to torsional vibration at resonant speeds. A clear conception of damped and undamped vibrations, damping coefficient, the dynamic magnifier, etc., is first given and their application is then illustrated in the design of vibration recording instruments, vibrographs, accelerometers or flexibly supported machines. This is followed by the study of exciting and damping forces with reference to propellers, air-screws and engines. The cases of apparent damping—as contrasted with the usual type of damping which functions by changing the vibrational energy into heat—viscous damping, overall damping and elastic hysteresis damping are then discussed with special reference to engine crankshaft systems. A brief account is then given of the nature and physical properties of the materials used in the manufacture of these crankshafts and this is followed by the calculation of torsional vibration stresses in them, illustrated with reference to all possible types. Typical stress diagrams are also given.

The next chapter (Ch. 8) is devoted to a detailed description and method of using different types of instruments for the measurement of torsional vibration amplitudes and stresses. The Junkers Torsiograph, the Geiger Torsiograph for low and high speeds, the D. V. L. Torsiograph, the Rotational Accelerometer, Askania Hand Torsiograph, M. I. T. Sperry Torsional Vibration Measuring Equipment, the R. A. E. Mark Va Torsiograph, the D. V. L. Recording Torsionmeter are all described with necessary details and methods of using and calibration. How the torsiograph records obtained from these instruments can be analysed and measurements made are illustrated in the next chapter, taking into consideration all typical cases. This is followed, in Chapter 10, by an exhaustive study of the methods adopted for securing a safe working speed range by an appropriate adjustment of the natural frequency or in other words by reducing the amplitude of torsional vibration by altering the position of critical speed. Four such methods are given in good detail. In all these the reduction of vibration amplitudes is accomplished without any appreciable absorption of the exciting energy. By frictional damping devices, however, it is possible to introduce into the system additional work absorbing forces which operate when the amplitude exceeds a predetermined amount; three methods of doing this have been described. In multi-cylinder engines it is sometimes possible to obtain a favourable damping effect by a different method, by alteration of the firing order, and the author has shown with illustrative examples, how this can be effected.

Another outstanding achievement in the development of vibration absorbers is that of the Rotating Pendulum Vibration Absorber. This, as the author has pointed out in his preface to the volume, is one of the most valuable contributions to the aircraft engine design in many years. An exhaustive study of its theory and constructional details forms the subject-matter of one big chapter (Ch. 11).

Yet another case in which the problem of torsional vibration comes into great prominence is in the direct coupling of d.c. or a.c. generating sets to internal combustion engines. In the last chapter the dynamic characteristics of such generating sets are discussed in full and suitable methods are suggested to keep the coefficient of cyclic irregularity to within desirable limits.

This second volume is as profusely illustrated with sketches and photographs as the first, and the number of numerical examples actually worked out with a view to elucidate the principles, is equally large. The two volumes together should be a very valuable guide to the designing engineer who has to tackle problems on torsional vibration.

E. K. R.

Bureau of Education: **Education in India, 1938-39.** (Government of India Press, Calcutta), 1941. Pp. 138. Price Rs. 3.

This Report has followed very closely upon the heels of the previous one for the year 1937–38. Indeed the early appearance of this Report was already foreshadowed in the preface to the previous one. While one must certainly appreciate the speed with which the work has been done, one also wonders whether in a country where education moves at the pace of a snail it is really worth while to have such elaborate annual Reports. It would appear that if any striking progress is to be recorded, and if educationists and the general public are to understand the trend of this progress, a period of at least five years should elapse between the appearance of one Report and the next.

The present Report closely resembles the previous one for 1937–38 both in regard to the content and manner of presentation. Hence the suggestions made in reviewing the previous Report, as to the desirability of providing a more suitable format, an index of topics, and bold headings for chapters, apply here also.

In a short review such as this, it is perhaps best to confine one's attention to one or two of the most outstanding features of the Report. Recent thought in Indian education has directed itself to the answering of two fundamental questions. Firstly, what is the type of education best suited to this country? Secondly, how is this education to be financed? The attempt to answer these questions has led to the formulation of two well-known schemes, the Wardha Scheme and the Vidya Mandir Scheme. Considerable reference is made to both these schemes in the Report under review.

The Wardha Scheme primarily addresses itself to the question of the type of education needed in this country and recommends emphasis upon the handicrafts. The Vidya Mandir Scheme, on the other hand, primarily concerns itself with the financing of popular schools and suggests the creation of numerous local endowments in lands and money as in the case of temples. The Report is generally sympathetic to the fundamental ideas in these schemes.

But the very origin of these schemes must be traced to the acute and growing unemployment of educated persons in recent years. It was felt that one of the most important causes for this state of things was the prevailing literary character of our educational system which produced persons who could not readily fit into the economic structure of the country. In order to consider this problem Messrs Abbott and Wood were invited to India. Their Report, which is especially concerned with the higher stages of education, advocates vocationalization and the diversion of students from university courses into practical walks of life. The Report under review deals at some length with this problem and indicates the provinces in India where new organizations along these lines are under way.

D. S. Gordon.

MECHANISM AND CHEMICAL KINETICS OF ORGANIC REACTIONS*—A REVIEW

THE Faraday Society has brought out a timely discussion on this topic, a stock-taking of work that has been carried out in the last fifteen years. As Professor Ingold rightly remarks in his introduction, "the contributors have had before them the ideal of the elevation of organic chemistry to a physical status, by the supersession of its old empiricisms and recipes by physical understanding and exact technique".

Grouping together of the papers will be doing them scant justice as they cover a varied field and the following paragraphs deal with the several papers briefly.

Ingold, Hughes and co-workers have been investigating the mechanism of elimination reactions for over a decade and the two papers represent a report on the present position. The contribution by Dr. E. D. Hughes is divided into two parts, general principles and special applications. The earlier section gives a general account of substitution reactions, the duality of the mechanism and the influence of reactants and of solvents on the mechanism. In connection with the unimolecular mechanism, it is stated that "the rate controlling ionisation is slow because it has to pass over an energy maximum which occurs at a certain critical extension of the bond and a certain critical degree of charge transfer," and in the foot-note "that solvation must reduce activation energy by an amount of the order of magnitude of the bond strength". This is an interesting idea but is solvation a necessary preliminary in the case of all the compounds where substitution is studied? The evidence for a dual mechanism in both solvolytic and non-solvolytic reactions is well brought out. In the later section, the reactivity of neopentyl halides and the influence of halogens, the carbonyl, vinyl and aryl and allyl groups on solvolysis is discussed. It will be interesting to see in greater detail some of the unpublished results of kinetic studies referred to. As the paper indicates, more work on anionotropic systems is necessary.

The problem of aliphatic substitution is closely allied to that of elimination reactions and, as in the former case, a duality of mechanism is found necessary here also.

The study of 'Onium degradations under varying conditions has brought out the similarity between elimination by bimolecular (E_2) and nucleophilic substitution by bimolecular mechanism ($S_N 2$). Evidence, though not so complete, is also available to indicate a similar slow stage for unimolecular mechanisms E_1 and $S_N 1$. The paper includes a clear discussion of environmental influences on the reaction, including the cases where both elimination and substitution occur together. The importance of kinetic studies in understanding the mechanism is well brought out. The last section of the paper deals with constitutional influences. An explanation of the Hofmann Rule which is related to the inductive effect and the Saytzeff Rule related to the tautomeric effect leads to a discussion of the combined effects which is well illustrated by a study of tertiary amyl compounds. Attention has been confined in the paper to only 1 : 2 elimination since quantitative studies on other eliminations are inadequate.

J. N. E. Day and C. K. Ingold discuss the mechanism of hydrolysis and esterification. The main division of mechanism for both types of reactions depends on whether or not a preliminary proton transfer to the carboxyl compound is necessary for the reaction. A further division is introduced by considering the position of rupture, the bonds involved being acyl-oxygen or alkyl oxygen. The different alternative mechanisms which have been labelled are discussed and in the final section is given a summary of the mechanisms and a table showing the diagnostic characteristics of mechanism by which these may be recognised.

Dr. H. B. Watson has contributed two papers dealing with carbonyl compounds. In the first he has discussed the acid and base catalysed condensation reactions of carbonyl compounds and has briefly indicated the mechanism of aldol condensation, Knoevanagel and Claisen reactions and Michael addition. The second paper deals with the influence of substituents and the acid and base catalysed prototropy in carbonyl compounds.

* *Transactions of the Faraday Society*, December 1941.

Based on the earlier work of Haber and Willstätter, Weiss has discussed the Canizzaro reaction and outlined a mechanism which is found to accord with experimental data on the kinetics, the reaction in heavy water, etc., and the action of alcoholates. The simple processes of electron or hydrogen transfers, for which the energy requirements are satisfied, renders the free radical mechanism acceptable, especially with the important reference to peroxide catalysis. While the benzoin condensation may be related to the Canizzaro reaction, as Ingold rightly points out in the discussion, there is no compelling evidence adduced by Weiss in support of his scheme to eliminate the Lapworth mechanism.

Gwynn Williams has discussed the addition to olefinic compounds. In spite of the general nature of the title, attention is practically confined to only halogen additions. The evidence for establishing the complex nature of the reaction is well presented though in discussing the final mechanism, a comprehensive scheme proposed by Leighton[1] appears to be ignored. Gwynn Williams also glosses over the difficulty of stereochemical isomer formation and the interconversion geometrical isomers in the process.

Blaughan and Polanyi have developed the theory of activation energy of "negative substitution" simplifying the calculations of Ogg and Polanyi. The simplification is found applicable to symmetrical substitutions. While the model of the transition state of these authors is useful for calculations, the evidence provided does not completely eliminate the symmetrical charge model of Hughes. The calculations make use of the extension of bond necessary and the potential energy of $C-X$ bond. For the former an empirical revision of ionic radii leads to an extension of 0·59Å in the C—Hal bond, while for the potential energy curves, both Morses' equation and Linnet's equation lead to approximately similar results. In the last section, the solvent effect is considered and appears to be negligible.

Balfe and Kenyon discuss the mechanism of anionotropic change suggesting an ionic mechanism in which rearrangement is associated with retention of optical activity while replacement involves racemisation. In the course of the discussion of their work on allyl alcohol and its derivatives, the authors suggest for these some sort of co-ordination between the hydroxyl group and the γ-carbon atom. It is obvious that more work of a kinetic nature is needed in the field for a proper understanding of the phenomenon.

Bradfield and Jones review the present position of electrophilic benzene substitution reactions. The most extensive studies have been on nitration and for this reaction, the comprehensive work of Holleman interpreted by the authors and the kinetic studies of Ingold and co-workers naturally cover the ground. The correlation of the kinetic studies with the dipole moment deduced by Eyining and Ri is indicated towards the end. Sulphonation has not been studied with the same thoroughness. The only important mechanistic study appears to be that of Vicary and Hinshelwood and obviously more work is needed before any comprehensive mechanism can be given. A number of kinetic studies on halogenation indicate that the process involves halogen molecules and not atoms in nuclear substitution. The work of Wibaut at high temperatures is referred to, though the reaction is heterogeneous and in the gas phase, but no explanation of the abnormality is given in the body of the paper. Waters, however, suggests in the discussion that in these cases, halogenation involves halogen atoms. The paper contains a thorough discussion of the halogenation of phenols and ethers. The relative rates given at the end may not be very significant until more is known about group-interactions than we do at present.

Baker contributes an interesting treatment of the problem of side-chain substitution by the method of relative energy levels. Attention is confined to bimolecular nucleophilic substitutions. While the arbitrariness in procedure precludes any significance for the figures given on an absolute basis, a reasonable approach to a comparative study is provided and group influence is discussed on this basis.

Fairbrother discusses the mechanism of the Friedel and Crafts' reaction. The primary stage involves the transformation of carbon-halogen bond to the ionic condition with the formation of a complex with the metal halide catalysis. The evidence of isotopic exchange is adduced in support of

[1] *Photochemie*, A. A. Noyes, P. A. Leighton, Rollefson, Hermann et Cie.

this view. Measurements of dielectric polarizability also lead to the same conclusion in cyclohexane solution.

Reactions involving free radicals are considered by Waters. Free radicals are shown to be reagents of an electrophilic type. The velocity of all reactions involving free radicals depend on their rate of production from stable covalent molecules. Recombination of free radicals involves little activation energy. One section deals with the meagre information available on the kinetics of catalysed free radical reactions. Solvent effects are considered both where the solvent is a reactant and where it is only a diluent.

The kinetics of ring closure is discussed by G. M. Bennett who summarises the work done by him and his colleagues in the last decade on a variety of ring closure reactions. The factors involved are well discussed and Carothers' work on ring closure and an explanation of Ruzicka's experiments are considered in the last section.

As is the case with all Faraday Society discussions, the discussion following each paper is an important contribution to the elucidation of the problems and the whole collection of papers provides a stimulus for further work in several fields.

S. V. ANANTAKRISHNAN.

CHINESE LESSONS TO WESTERN MEDICINE

Chinese Lessons to Western Medicine. By I. Snapper. Foreword by G. R. Minot. (Interscience Publ., New York), 1941. Pp. 380, 132 illustrations. Price \$5·50.

THE author, a distinguished Dutch physician and research worker, describes systematically the clinical experiences, well founded on laboratory investigations, collected by him as professor and head of the department of medicine, Peiping Union Medical College, Peiping, China. This teaching and research hospital, founded twenty years ago and supported since then by the China Medical Board, Inc., a branch of the Rockefeller Foundation, is of such a high standard, compared even with the best institutions in the West, that these "lessons" need careful attention. From the introduction, which contains information on organisation and administration, it should be noted that the final (fifth) year students live and work for a full year as internes at the hospital. The great difficulty in obtaining permission for the performance of postmortems, one of the most serious obstacles in the way of medical progress in our country, was overcome to a great extent by signing post-mortem papers (permitting post-mortems) *before* admission of the patients. A good attempt was made towards the solution of the blood-donor-question, complicated, there as here, by superstitions, multiple infections and undernutrition. The first chapter, concerned with *nutritional problems and avitaminoses,* shows the all-importance of malnutrition, which modifies almost all clinical pictures in North China. Peiping-diet is deficient in proteins, calcium, vitamin A, C and D; whereas B-deficiency is prominent in the rice-eating South of China just as in South-India, the population of North-China gets all the necessary vitamin B from millet, which is eaten unmilled like ragi. The next chapter deals with *infectious diseases.* Diphtheria seems to be more toxic than here. Scarlet fever, which is a great rarity among Indians, is endemic in Peiping. Pneumonia presents the same picture as here, though influenzal pneumonias seem to be more common. Mumps (epidemic parotitis) is frequently accompanied or followed by neurological complications, such as encephalitis, meningitis, radiculitis or peripheral neuritis; interesting case histories illustrate the author's experiences in this as in other chapters. The description of typhus fever is not detailed enough to make a comparison with the different groups of Indian typhus possible. However, murine flea-borne rickettsias as well as human, louse-borne strains seem to be responsible there. Louse-bearing relapsing fever is very common and presents diagnostic difficulties, many cases being atypical and complicated with Salmonella enteridis infection. Bacillary dysentery is of astounding frequency; the differentiation of the many chronic cases from chronic ulcerative colitis is described. Cases of entero-colitis are encountered which show a degree of dehydration and acidosis, still worse than in cholera; they respond quickly to parental glucose

and saline administration. Amebiasis and liver abscess present important diagnostic problems; cases are described where amebiasis caused severe appendicitis, cecum perforation or psoas abscess; in such cases amebæ were frequently absent in the stool. Photos show amebiasis of the skin. "The parasitic disease which places its mark all over internal medicine in North China is kala-azar", comparable with the role which malaria and ancylostomiasis play in South India. The diagnostic procedure is puncture of the sternal marrow; the routine treatment: ureastibamine or neostibosan, to which even many cases of severe noma respond quickly. Sand-flies transfer kala-azar from dogs either to dogs or to men (good photos of canine k.-a.). The part on encephalitis brings valuable observations and a clear-cut diagnosis of the type B, due to the Japanese virus, from type A, which is not to be found in Peiping at present. The author's unfavourable experiences with rabies vaccination differ from those made in India. Chapter III deals with pulmonary, intestinal and peritoneal *tuberculosis*; a case history of tuberculosis of the pylorus is illustrated by a radiogram and the histological picture. In Chapter IV the rarity of *amyloid degeneration,* in spite of the frequent occurrence of chronic tuberculosis and osteomyelitis, is traced to the absence of dairy products in the local diet. Chapter V is concerned with *cardio-vascular diseases.* Rheumatic valvular disease, not rarely combined with vascular syphilis, occurs frequently; but a typical history of rheumatic fever preceding it, is usually absent, just as is found in India. Arteriosclerosis, coronary thrombosis, diabetic and senile gangrene are remarkably rare. The syndrome of "hypertensive cardio-vascular disease" (fundal changes, etc.) is found with a surprisingly low blood-pressure; the extreme high blood-pressure figures which we see here in essential hypertension among strictest vegetarians are not described. Pick's syndrome and aneurysms are frequent; case histories and photos show the diagnostic difficulties of the former, the various symptoms and signs of the latter. Subacute bacterial endocarditis is frequently seen, which differs from the observations in this part of India. Whereas in Peiping, thromboangiitis obliterans (Buerger's disease) is not more common than in the West, it is very frequently found in South India; both observations point towards the independence of this condition from a previous typhus fever; in the endemic typhus area of North China thromboangiitis is not very common; here, where typhus is rather rare, it is surprisingly frequent. In Chapter VI *renal affections* are discussed. Glomerulo-nephritis is traced to skin affections (pyodermia) rather than to tonsillitis, etc. Some cases may be related to malaria, possibly as an anaphylactic reaction;* chronic nephrosis mostly is seen accompanied or followed by some glomerular lesion, which determines finally the renal failure. A slight renal acidosis leads to renal osteodystrophy because the chronic deficiency of calcium and vitamin D favours these skeletal changes. The rarity of renal stones in spite of vitamin A deficiency is explained by the low calcium intake. The author's experiences on coliform group infections, which are widely spread and frequently missed here, would be of interest. *Diseases of the liver and biliary system* are dealt with in Chapter VII. Catarrhal jaundice hardly ever leads to acute yellow atrophy and arsphenamine causes jaundice exceptionally—in spite of the poor nutritional condition, observations which are in accord with these made in South India. Hydatid cysts derived from sheep are not infrequent; cases of diagnostic interest are reported. Cirrhosis of the liver, of Laennec's or portal type is very frequent, though alcohol consumption is low; dysentery and semi-starvation are suspected as causative factors. Low albumin content of the blood plasma favours the development of ascites. The anatomical conditions for the development and the diagnostic importance of venous hum in the xiphoid region are discussed. Fever in cirrhosis indicates portal thrombosis. The frequent cases of splenomegaly with anæmia and leucopenia without a frank cirrhosis of the liver are called Banti's syndrome, though the histological picture of the spleen differs from the original description. However splenectomy causes a quick improvement of the anæmia and thrombocytopenia. Banti's disease with hæmorrhage from stomach or intestines is differentiated as splenic thrombosis, which does not lead to cirrhosis of the liver and is benefited by splenectomy

* *Cf.* Heilig, R., *Ind. Med. Gaz.*, **1941**, **76**, 519.

equally well. Primary carcinoma of the liver, usually developing in a cirrhosis, is common. Gallstones are comparatively rare; they are equally distributed between men and women; no cholesterol—but calcium bilirubinate—stones are seen and easily visualized by X-ray. Cholecystitis, mostly of E. coli origin, occurs frequently; hints are given here in differentiating it from hepatitis and liver abscess. Important observations on *anœmia* are communicated in Chapter VIII. Hypochromic, iron deficiency anæmias are common. But the author deals mainly with nutritional macrocytic forms with or without megaloblastic bone marrow; most of them respond well to yeast. Some of those cases very much resemble genuine pernicious anæmia; their improving on yeast or on very small doses of liver, so far as blood picture and the frequent neurological signs are concerned, the absence of hæmolysis and poikylocytosis and the reappearance of free hydrochloric acid when the anæmia is cured, differentiate them from it. This macrocytic anæmia is caused by the deficiency of the extrinsic factor in the food. A case is reported, showing hypofunction of the anterior pituitary lobe, hypogonadism, achlorhydria and macrocytic anæmia, a syndrome, previously defined by the author. All kinds of hæmorrhagic diathesis are frequently encountered; cases of true and sporadic hæmophilia, thrombocytopenic and anaphylactoid purpura and agranulocytosis are described. Leukæmias show the usual picture. In Chapter IX, which contains *some remarks about malignant tumours,* comparative figures are given on the frequency of carcinoma of the liver. An interesting discussion follows on the different types of lymph gland tumours, especially reticulosarcoma and lymphoepithelioma, the most common members of that group in North China; they are frequently small primary tumours of the lymphoid structures of the mouth or nasopharynx; they invade the base of the skull and develop large metastases first in the cervical glands, later all over the body. Lymphosarcoma occurs frequently and causes gastrointestinal complaints. *Intoxications* are treated in Chapter X. Addiction is found not only to opium, which is smoked by all classes without doing much harm, but also to heroin, which is used as an intravenous injection in the final stages and ruins the addicts who belong mostly to the lowest classes. In suicide the usual poisons are opium and barbital (veronal). The very serious prognosis in opium-poisoning seems to have somewhat improved by the routine treatment with the "iron lung" (Drinker's respirator) and intravenous coramin-injections (3 c.c. maximum); those poisoned with barbiturates need heroic doses of strychnine (10 mg. = gr. $^1/_6$ repeated every half or one hour up to hundreds of milligrams) and intravenous glucose infusions. Drug poisoning is seen due to the use of indigenous mercury remedies and castor beans (ricin). In the final chapter on *miscellaneous diseases* it is noteworthy that cysticercosis (especially of the skin) is a very common ailment. Diabetes is frequently encountered; its benign course is explained by the low caloric intake and the absence of butter from the food; vegetable oils with their long chains of partially unsaturated fatty acids are hardly ketogenic. Endocrine disorders—apart from Grave's disease—are rare, osteomalacia and late rickets very common. The extremely well written book, which bears witness to the deep knowledge and keen interest in the new surroundings of the author as well, as to the high standard of his clinical and, especially, his laboratory staff, should be read by every clinician interested in clinical research in general and in geographical (comparative) medicine in special. One hundred and thirty-two illustrations, many of them excellent photos and radiograms, increase the didactic value of these Chinese-Dutch lessons to medicine all over the world.

ROBERT HEILIG.

THE CHEMISTRY AND THERAPY OF GLANDULAR PRODUCTS*

BY

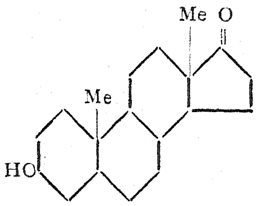
PROF. B. B. DEY

(*Presidency College, Madras*)

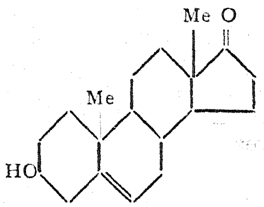
THE researches carried out in the field of hormones in the last two decades have been so extensive that only a cursory glance at the main results can be given in this short review.

Sex Glands.—The sex hormones may be considered to be made up of the testicular, the follicular and the progestational principles. The present-day advance in this field is largely due to the happy discovery that human urine and the serum of pregnant mares form an excellent source of the male and the female hormones, so that sufficient material could be accumulated for chemical as well as therapeutical investigations. Another equally important contributory factor has been the elaboration of two very important methods of biological assay, *viz.*, "The capon-comb test" for the male hormones and the "vaginal smear test" for the œstrogenic hormones. The isolation of these hormones is based on the general principle of extraction by means of fat solvents and concentration by means of selective distribution between suitable organic solvents.

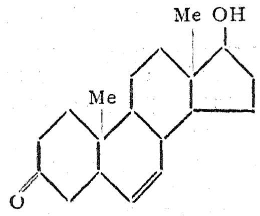
Among the male hormones are Androsterone, Trans-Dehydro-Androsterone and Testosterone, the most potent being Testosterone which is therefore to be considered as the true testicular hormone. All of these hormones have been obtained in a pure crystalline condition and their structures, represented below, have been elucidated by degradation reactions as well as by partial syntheses from known sterol derivatives.



Androsterone



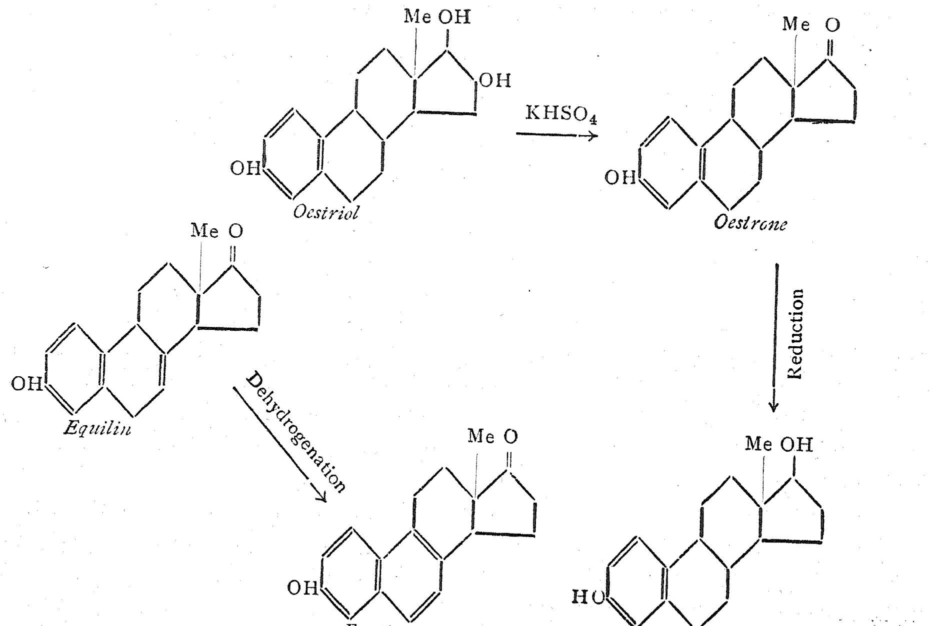
Trans-Dehydro-Androsterone



Testosterone

The ovarian hormones play a most important part in the sexual cycle of the female. The "œstrogenic" or the "follicular hormones" induce the development of the uterus, of the vagina and of the mammary glands; the corpus luteum or the "progestational hormones" prepare the uterus for the embedding of the fertilised ovum. Among the œstrogenic hormones are Œstrone, Œstriol, Œstradiol, Equilin, Hippulin and Equilenin. Of these the œstradiols are the most active and should be regarded as the true ovarian hormones. The constitution, as well as the interrelationships of these hormones are brought out in the following scheme:

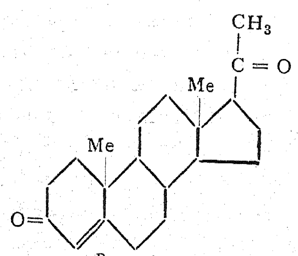
* A brief summary of a course of four lectures delivered under the auspices of the Madras University.



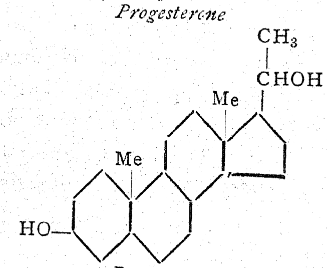
Oestriol *Oestrone* *Equilin* *Equilenin* *Oestradiol*

The structures of these compounds arrived at by degradation reactions have been confirmed by the brilliant total synthesis of Equilenin by Bachmann (1940), the first achievement of its kind in the field of sex hormone synthesis.

Among the corpus luteum hormones are Progesterone and Pregnandiol:



Progesterone



Pregnandiol

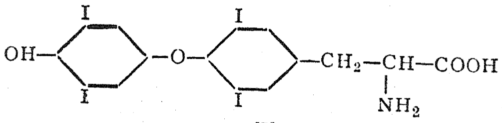
Pregnandiol is inactive and can be derived from Progesterone. The structure of progesterone has been established by its partial synthesis starting from stigmasterol. The drug is now commercially prepared from stigmasterol which in its turn is manufactured from soya beans.

All these sex hormones alike possess the cyclopentenophenanthrene ring structure, which, it will be recalled, is also the basic structure of a wide variety of biologically important products such as sterols, bile acids, heart poisons, saponins, carcinogenic hydrocarbons, cortical hormones and vitamin D.

Several of these products are commercial drugs and are extensively used in the treatment of sex disorders. An important development during the last few years has been the elaboration of the "pellet therapy" wherein pellets of the crystalline hormones are introduced subcutaneously and made to act slowly and steadily, thereby simulating the action of the normal endocrine glands.

The Thyroid Gland.—The endocrine function of the thyroid was recognised very early; in fact Murray laid the foundation of the science of organotherapy in 1891 when he administered extracts of sheep's thyroid glands for the treatment of myxœdema. The gland produces a hormone which catalyses the oxidative

process in the body. The active principle of the gland was isolated by Kendall in 1914 by alkaline hydrolysis of the gland and was termed Thyroxine. Harington worked out its structure by degradation reactions and finally confirmed it by synthesis:



Thyroxine

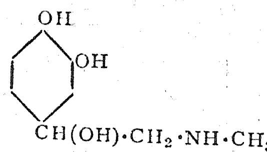
Both the natural and the synthetic products are now available in the market and are used for the treatment of hypothyroidism. For clinical purposes, however, desiccated thyroid (Thyroidium siccum) is the drug of choice. Recent investigations have shown that thyroxine does not account quantitatively for the activity of the whole thyroid and that thyroglobulin itself or a complex peptide of thyroxine is to be regarded as the real thyroidal hormone. One of the interesting developments of recent years has been the artificial production of iodinated proteins which possess the "thyroidal activity". It has been shown in several instances that small amounts of thyroxine could be actually isolated from these iodo-proteins.

The Parathyroid Gland.—The parathyroids are the smallest of the endocrine glands. They produce an internal secretion,—*viz.*, "parathormone"—which is concerned with the regulation of calcium metabolism and with controlling in some way the concentration of calcium and phosphorus in the blood. Tetany which follows the surgical removal of the parathyroids is due to the lowering of the blood calcium. Recent researches go to show that the primary action of the parathyroid hormone is on the phosphorus metabolism and that changes in the Ca-metabolism are but consequent to alterations of the P-metabolism.

Parathormone is believed to be of the nature of a protein but it has not yet been obtained in a pure crystalline condition. The preparation is based on the fact that the protein can be extracted by means of hot dilute acids. Substitution therapy with parathyroid extracts to relieve cases of parathyroid deficiency has now fallen out of practice, its place being taken up by irradiated sterols like vitamin D_2 and dihydrotachysterol (A.T. 10).

The Adrenal Gland.— The adrenal gland is made of two structurally different parts, the medulla and the cortex, which are entirely different with regard to the internal secretions elaborated by them.

The Medulla.—The discovery of Oliver and Schafer (1894) that adrenal extracts raised the blood pressure aroused great scientific interest and attempts were carried out in Abel's laboratory to isolate the active principle. Success finally fell to the lot of Takamine and Aldrich (1901) who were able to isolate it in a pure crystalline condition. The name Adrenaline or Epinephrine was given to it and the constitution was established by synthesis. The glandular mass was extracted with acidulated water and after removal of lipoidal contaminants, the pure base was precipitated with ammonia.



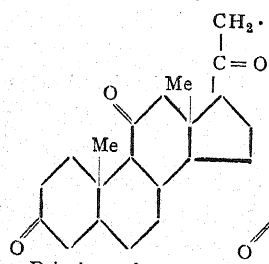
Adrenaline

Adrenaline stimulates the action of the sympathetic nervous system and is therefore called a sympathomimetic drug. It raises the blood pressure when injected subcutaneously and also mobilises the liver glycogen and so raises the blood sugar; its action in this respect is therefore antagonistic to that of insulin. For this and other reasons, Adrenaline finds extensive therapeutic usage, such as in the treatment of allergic disorders, in reviving the heart beat when it stops accidentally during surgical operations, in counteracting an overdosage of insulin and also in admixing with various local anæsthetics for prolonging their action. It is considered by many to be the hormone of emergency.

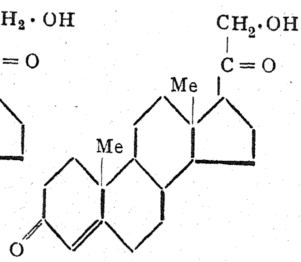
The Adrenal Cortex.—Researches carried out during recent years go to show that the adrenal cortex may indeed occupy a position in the whole endocrine system second in importance

only to that of the pituitary gland. Stewart and Rogoff (1925) showed that the cortex was essential for life. Hartman prepared active extracts of the cortex for which the name "Cortin" was given. The method consisted in extraction of the minced cortical tissue with alcohol or ether and concentration by selective distribution between various organic solvents. The brilliant investigations carried out during the years 1936–1941 by three groups of workers, Kendall and Wintersteiner in America and Reichstein in Switzerland (Zürich) have resulted in the isolation of about twenty closely related steroid derivatives, some active and others inactive, from the crude extract "cortin".

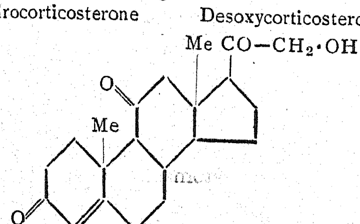
Among the more important of these cortical hormones are Corticosterone, Desoxycorticosterone and Dehydrocorticosterone.



Dehydrocorticosterone



Desoxycorticosterone



Corticosterone

The structures were established by degradation reactions when steroids of known structure were obtained. Steiger and Reichstein (1937) also succeeded in partially synthesising desoxycorticosterone, starting originally from stigmasterol. Desoxycorticosterone is now available for the treatment of Addison's disease and other ailments traced to cortical deficiency, and is manufactured by the synthetical method.

It is now generally agreed that the cortex does not elaborate any single substance which can be regarded as the true hormone of the gland, but that it produces a surprisingly large number of closely related compounds which have specific effects differing qualitatively one from the other. These hormones control the metabolism of salt, water, potassium and carbohydrates and also the renal function. Addison's disease, which was recognised as early as 1855, has now been definitely shown to be associated with the adrenal cortex.

The Pituitary Gland.—The pituitary is the most important, complex and interesting of all the ductless glands and has been referred to by Sir Henry Dale as "the conductor of the endocrine orchestra". The gland is made up of two distinct portions—the anterior lobe and the posterior lobe, joined together by the "Pars Intermedia". A battery of hormones is elaborated by the pituitary but none have so far been obtained in a pure condition with certainty. Highly active fractions have been prepared and some placed on the market. The hormones are probably all of a protein nature.

The Posterior Lobe.—An aqueous acid extract of the posterior lobe yields "pituitrin" which raises the blood pressure and stimulates uterine contraction and also controls the renal excretion of water. The work of Kamm has however shown that pituitrin is not a homogeneous substance, but can be resolved into (1) Oxytocin, which causes the contraction of the uterus and (2) Vasopressin, which increases the blood pressure and also exerts an anti-diuretic effect. Active extracts of the posterior lobe of the pituitary find important applications in obstetrics and also in the treatment of "diabetes insipidus".

The intermediary lobe is supposed to secrete a hormone known as "Intermedin"; its definite function in man has not yet been made clear but it has been shown to produce characteristic colour changes in the frog and in certain species of fish.

The anterior lobe produces a very large number of hormones which can be broadly classified under two headings, *viz.*, (1) those which produce general effects in the whole body and of which examples are to be found in the growth-promoting principle which has been

placed in the market under the name "Antuitrin-Growth" and the "Glycotropic principle" or the "Diabetogenic hormone", injections of which raise the blood sugar, and (2) those which produce specific effects on other glands. The anterior lobe of the pituitary is known to control and co-ordinate the endocrinal activities of the other glands and in its turn to be influenced by them. Thus the "Thyreotropic hormone" stimulates the thyroid gland and the "Corticotropic hormone" produces hypertrophy of the adrenal cortex. But much more important are the "Gonadotropic hormones", which have been shown to produce two different effects, *viz.*, follicular stimulation and luteinisation. Recently there have been claims for having isolated the two different principles in a pure condition. It is interesting to note that similar gonadotropic hormones appear in the urine during pregnancy and are produced by the chorionic tissue.

The Pancreas.—The work of Minkowski and Mehring in 1889 definitely established the relation between pancreas and diabetes mellitus. Active extracts of the pancreas which could be successfully employed in the treatment of diabetic patients were first obtained by the Toronto group of workers—Banting, Best, McLeod and Collip. The isolation of insulin created almost a revolution in medical practice for it made the definite control of this disease and the alleviation of the sufferings of the diabetic patients possible. The method of isolation of the hormone consists, in general, in extraction with acidified alcohol, precipitation with ammonium sulphate and final iso-electric precipitation. Of late, methods have been developed to crystallise insulin and they depend on the presence in minute traces of metals like zinc. Insulin has a molecular weight of about 35,000 and is believed to be a pure protein since hydrolysis results in the production exclusively of a number of amino-acids. Recent researches have shown that diabetes may not be due primarily to the deficiency of the secretion of insulin by the pancreas, but rather to certain other hormonal disturbances, especially of the pituitary. A number of attempts were made to prolong the hypoglycemic action of insulin, so as to avoid the necessity of giving frequent injections: the introduction of "Protamine-Insulin" by Hagedorn in 1935 and its modification by Scott into "Protamine-Zinc-Insulin" in the following year, together constitute a great advance in this direction. Certain groups of workers have recently claimed to have isolated a second internal secretion of the pancreas which has been named "Lipocaic", and which is believed to control fat-metabolism.

The Liver.—In 1929 Minot and Murphy showed that pernicious anæmia could be cured by the inclusion of liver in the diet. Attempts have been made ever since to isolate the anti-anæmic liver principle but up to now no preparation can claim to be homogeneous. Cohn prepared an active fraction—Fraction G—which was further purified by Dakin and West, who used "Reinecke Salt" to precipitate the active fraction and who believed it to be a complex peptide. The more recent researches of Subbarow and Jacobson have shown that the active principle is of a composite nature and that progressive purification leads to a gradual loss of potency due to the elimination of certain "accessory factors". Castle postulated the existence in the stomach of an enzyme—the "intrinsic factor"—which reacted with an "extrinsic factor" present in the food material to give rise to the antianæmic factor which was stored in the liver and sent from there to the bone marrow for haemopoiesis. Pernicious anæmia is therefore due primarily to the deficiency of the intrinsic factor and so the treatment consists in either supplying the intrinsic factor in the form of stomach preparations whereby the elaboration of the haemopoietic principle by the stomach is stimulated, or, by the actual administration of the preformed active principle in the form of liver extracts.

THE TWELFTH CONFERENCE OF THE INDIAN MATHEMATICAL SOCIETY, ALIGARH, 1941

THE INDIAN MATHEMATICAL SOCIETY held its twelfth conference at Aligarh at the Muslim University on the 27th, 28th and the 30th of December 1941. The delegates were welcomed by Prof. A. B. A. Haleem, Pro-Vice-Chancellor, who gave a brief history of the Muslim University and stressed the need for improving the methods of teaching mathematics in the country. The Conference was opened by Sir Zia-ud-din Ahmad, Vice-Chancellor of the University, who among other matters referred to the importance of a great mathematical work by El-Beruni called *Kanoon Masoodi* written in 1038, the translation and editing of which would throw light on the influence of Indian and Greek Astronomy on the researches of the Arabs. The Report of the Society's activities was read by the Secretary, Dr. Ram Behari, of Delhi University.

In his Presidential Address, Dr. R. Vythynathaswami (Madras) said that college instruction could not be separated from research except to its detriment and degradation. Mathematical discovery, he said, was a baptismal experience of something fresh rising in the human consciousness and miraculously revealing a new world of values—an experience which was enshrined in the Vedic Symbolism of *Ushas*, the Deity of the Dawn, or in the glamorous figure of *Lakshmi* rising from the Ocean of milk churned by the *Devas* and the *Asuras*. He then traced the various "dawns" that had illumined and transformed the mathematical outlook at various times and had given a deeper insight into the nature of mathematical thought.

The session was well attended by delegates from different parts of India and over 50 papers were contributed to the Conference. Besides the reading of the papers, there were three symposia—one on "Fourier Integrals and Transforms" with Dr. R. S. Varma of Lucknow presiding, a second on "Group Theory" under the Chairmanship of Dr. F. W. Levi (Calcutta) and a third on "The Origin of the Solar System" presided over by Prof. A. C. Banerji (Allahabad).

There were two evening lectures, one by Dr. A. Narasinga Rao (Annamalainagar) on "Mathematics and Modern Warfare" and the other by Dr. B. Ramamurti (Ajmer) on "How to make the Teaching of Mathematics interesting". Prof. D. D. Kosambi (Poona) addressed the students of the Mathematics Association of the Muslim University on the evening of the 27th December.

As usual there was a Business Meeting of the Society and a Discussion on the Teaching of Mathematics in Schools and Colleges initiated by Sir Zia-ud-din Ahmad.

Special features which made the Aligarh Conference noteworthy were the Annual Session of the Benares Mathematical Society held for the first time in collaboration with the Indian Mathematical Conference, and the announcement of a prize to be awarded once in two years for the encouragement of mathematical research which Prof. A. Narasinga Rao offered to institute. The details of the prize are under consideration by the Committee of the Indian Mathematical Society.

A. NARASINGA RAO.

DRIVE AGAINST MALARIA IN INDIAN CANTONMENTS

THE announcement of a drive against malaria in Indian Cantonments is a significant forward move in a country where malaria forms one of the major health problems. It is estimated on a rough computation that nearly a million deaths a year are directly due to malaria and that at least a hundred times as many people are suffering from the disease. The epoch making discovery of Sir Ronald Ross, elucidating the mechanism of malaria transmission in 1895, was quickly put to test in the field and there have been numerous outstanding examples of control of malaria in mainly urban areas and of populations under control, in several parts of the world.

While available methods of malaria control have been made use of in a few urban areas in India including Cantonments, a more generalised use of these methods to cover extensive hyper-endemic malarious areas has been largely limited on account of peculiar local conditions. India is essentially rural and

till recently the measures available for the control of malaria were much too costly to permit a large-scale control of rural malaria.

Up till recently, measures available for the control of malaria were,

(1) permanent measures—anti-malaria engineering,
(2) recurrent measures—use of larvicides,
(3) naturalistic methods—use of natural enemies, etc., shading, and
(4) use of drugs.

These measures have been used singly and in combination in Indian Cantonments, and other large-scale public works where labour is under control and in a number of other places mostly urban, with good results.

Recent work on the use of insecticides for killing adult mosquitoes, has brought out pyrethrum extract as a most useful addition to the several measures already available. This measure consists in a regular spraying of an extract of pyrethrum diluted with kerosene, all day-time resting places of anopheline mosquitoes once or twice a week. Field trials, with this extract by a number of workers in India have indicated this method as an effective, and at the same time a cheap anti-malaria measure bringing the control of rural malaria within the realms of practical possibility.

The anti-malaria drive now being organised, has more than circumscribed interest. The co-ordination of civil and cantonment agencies for the purpose of malaria control avoids unnecessary overlapping and should yield better control. The neglect of control of the civil population living in close proximity to a cantonment area was a serious omission, now removed. A central control, co-ordinating the work in different units, will considerably help in developing improved technique and valuable standards for future development.

The most important feature of the scheme is the organisation for the training of personnel. Successful control of malaria, very largely depends on efficient direction by men who are well trained in the work. While this scheme supplies an immediate need, they will serve as a valuable nucleus for expanding the work to cover wider areas under peace-time conditions. The example of an effective control of this disease in areas normally hyper endemic for the disease, will have an excellent propaganda value in rapidly expanding this activity into rural areas where it is most needed.

B. Ananthaswamy Rao.

SCIENCE NOTES AND NEWS

Indo-European Trade Link.—Beads recovered from the archæological site at Taxila (near Rawalpindi, the Punjab) have provided proof of a trade connection between Europe and Asia before the time of Alexander, when typical European beads from settlements dating as far back as the 5th century B.C. were imported into India.

Mr. Horace C. Beck, the well-known expert on beads, has recorded in a monograph (published as Memoir No. 65 of the Archæological Survey of India) the results of the examination of about 950 selected beads dating from about 700 B.C. to 500 A.D., which were recovered from excavations at Taxila by Sir John Marshall for over two decades!

Mr. Beck has also found about half a dozen beads from Taxila which appear to belong to an altogether earlier civilization. Among other interesting types of beads are those representing animals, birds and forms of human life. These are undoubtedly associated with some symbolism and were probably used as amulets.

A number of glass beads from the Bhir Mound, the earliest site at Taxila, have been found to connect with early Mediterranean culture, being similar to finds recovered in Corsica, Sardinia, and the Etruscan tombs in Italy. The study of glass beads from the Sirkap site, which dates from 200 B.C. to 100 A.D. has, on the other hand, revealed some influence of the Roman Empire.

Applications of Quaternions to Relativity and Radiation Theory.—It is well known that the algebra of quaternions is particularly suitable for representing the rotation group as well as the Lorentz group. In a recent paper (*Proc. R.I.A.*, 1941, **46 A**, 129) P. Weiss uses the formalism of quaternions to derive an explicit formula expressing Lorentzian co-ordinates in terms of retarded co-ordinates, for an arbitrary world line of the observer. The 'retarded co-ordinates' are (i) the 'retarded distance' s, *i.e.*, what appears to the observer as the ordinary 3-dimensional distance, (ii) the proper time τ of the observer, (iii) two variables θ, ϕ parametrising the observer's proper sphere (*i.e.*, these points of the light cone which appear to the observer as a sphere of radius s with himself at the centre). Various applications are made of the formula so derived, *viz.*, the retarded electromagnetic field due to a point charge and the classical equations of motion of a radiating point charge. V. R. T.

Solving Eigen-value Problems by Factorisation.—A very interesting method for solving eigen-value problems of the second order by factorisation of the second order operator into two mutually adjoint first order operators was given sometime ago by E. Schrödinger (*Proc. R.I.A.*, 1940, **46 A**, 9). A slightly different version of the method was subsequently given by L. Infeld (*Phy. Rev.*, 1941, **59**, 9). In a

recent paper (*Proc. R.I.A.*, 1941, 46 A, 183) Schrödinger discusses further developments of the method such as the application to classical eigen-value problems with artificial boundary conditions and irrational eigen-values (problem of the vibrating string) to pairs of first order equations (spherical harmonics with spin) and finally to perturbation theory (Stark effect). The last-mentioned application rests on the circumstance that if the unperturbed problem has been solved by factorisation, it is often possible to introduce into the factorising linear operators small additional terms which produce the perturbing term in the Hamiltonian with sufficient accuracy. Where applicable the device has some advantage over the ordinary method as the perturbation of the eigen-values is obtained without troublesome quadratures and a closed expression is obtained for the perturbed eigenfunction instead of the well-known infinite series. V. R. T.

Salvage in the Milk Industry.—"A paper just issued by the Department of Scientific and Industrial Research (Water Pollution Research Technical Paper No. 8, H.M. Stationery Office, 1941. Price 4*sh.* net) is of special interest in view of the vital importance at the present time of ensuring that there is no waste of food. It is not generally realised to what extent milk and the valuable products and by-products from milk are lost in the waste washing waters from many milk collecting and distributing depots and milk products factories. During an investigation by the Water Pollution Research Board of the Department of Scientific and Industrial Research, information was collected on the amounts of valuable materials, such as milk, whey, and buttermilk, carried away in waste waters from the milk industry and on the extent to which these losses can be reduced by simple and inexpensive modifications in the operations in depots and factories and by more careful control of the processes of draining and washing milk churns, cheese vats, butter churns, and other equipment. It has been shown, for example, how the loss of milk can easily be reduced to give a total saving of at least 3 million gallons a year on the milk handled at all depots and factories in Great Britain.

"Even after all possible methods have been adopted to reduce losses, there remains the problem of disposal of waste waters containing milk and milk products. These waste waters are very polluting in character and much trouble has been caused by their effect on streams into which they have been discharged. Experiments in the laboratory and on a large scale have shown that it is possible to purify these waste waters by the activated sludge process and by filtration in percolating filters. These methods are similar in general principle to those in use in treating sewage at sewage works. The percolating filters were operated by a new method of "alternating double filtration", by which two filters were used in series with periodic change in the order of the filters in series. A full account is given of the operation of large-scale plants, showing that the waste waters can be satisfactorily treated to give a final effluent in which fish can live. The method using filtration is the more economical and convenient and the rate at which the waste waters can be treated in a double-filtration plant is considerably higher than is usual in the treatment of domestic sewage by the process of single filtration ordinarily used at sewage disposal works. Details are given of the design and size of plant required."

Heart and Circulation in Apoda: Amphibia.—The presence of an accessory sinus venosus in the heart of *Siphonops annulatus* (Amphibia: Apoda) has been reported by P. Sawaya (*Bol. Fac. Fil. Cien. Letr. Univ.*, S. Paulo XXII, 1941, No. 5, p. 209). It occurs in the angle between the left atrium and the ventricular base. As distinct from the principle sinus venosus, this is called *sinus venosus sinister*. The two communicate with each other by a narrow canal guarded by a valve which prevents the regurgitation of the blood from the large sinus to the small one. The *sinus venosus principalis* receives the posterior vena cava, and the right jugular while the *s. v. sinister* receives the left jugular vein. It is also intimately connected with the coronary system of the heart. The ventricle of *Siphonops annulatus* has a distinct coronary vessel system appearing on its surface as a compact net. The capillaries of this net carry the venous blood from the myocardium to both the *s. v. principalis* and *s. v. sinister*, those of the left side carrying the venous blood into *s. v. sinister*, while those on the right carrying it into *s. v. principalis*.

Observations on the cutaneous circulation of *S. annulatus* show that, correlated with the integumental respiration in this animal, as in other Amphibia, its circulation also is pronouncedly interesting. Two marginal vessels connected with each other in each segment by transverse vessels and by capillaries make the skin a highly vascularized organ, probably to make up for the reduced left lung in the animal.

Histopathological Effects of Certain Insecticides on the Midgut Wall of the Armyworm Larva.—The sixth instar larvæ of Laphygma (Prodenia) eridania, Cram, fed with lethal or large doses of poisons by the sandwich method, and after sufficiently long intervals of time, prepared by means of suitable histological methods, were subjected to critical examination. Similar preparations of larvæ that had not ingested poisons were also examined for comparison. It was found, that the ingestion of arsenicals (Lead arsenate; Paris Green; Calcium arsenate; Calcium arsenite; and Arsenic trioxide) was followed by disintegration of midgut epithelial cells, and damage to the midgut muscle fibres. The ingestion of sodium fluoride caused disintegration of the substance of the cytoplasm and nuclei of the epithelial cells. Sodium fluoaluminate brought about great disintegration of the epithelial cells of the larvæ, as well as obliterating the cross striations of the muscle fibres. No change in the epithelium or muscle fibres, however, followed, the ingestion of Barium fluesilicate,

and Phenothiazine (Thiodiphenylamine). (Woke, P. A., *J. Agric. Res.*, 1940, 61, No. 5).

Thermal Conductivity of Indian Timbers.—Results of investigations into the thermal conductivity of Indian timbers at the Forest Research Institute, Dehra Dun, has just been published [*Indian Forest Records (Utilisation)*, Vol. II, No. 6, pp. 150-67].

Among structural materials, wood, with its low thermal conductivity, makes an ideal material for house construction, water pipes, tanks, casings, railway and other carriages, drying chambers and cold rooms, etc. Further, thermal conductivity in conjunction with volumetric specific heat is helpful in determining the rate of change of temperature in wood when it is heated or cooled. A knowledge of this is necessary for studies in preservation of wood, sterilisation, fire-resistance, seasoning and the making of plywood.

In spite of the importance of thermal properties of wood, accurate data were almost entirely lacking. The Record now published contains the results of research on 56 species of Indian timbers in air-dry condition, the lightest specimen tested being *Bombax* (*semul*) and the heaviest, ebony.

The Story of Agmark.—The word "Agmark" was adopted by the Government of India as a symbol of purity. Standard methods of grading and marking have been laid down for a number of commodities, including ghee, eggs, fruits, fruit products, hides and skins, ata, rice, seed lac, tobacco, cotton, edible oils and gur. The story of Agmark dates back to the recommendation of the Royal Commission on Agriculture on devising ways and means for the better marketing of agricultural produce so that the producer may get a better return. A full account of it is given in a pamphlet recently issued by the Agricultural Marketing Adviser to the Government of India.

In the Agmark scheme of quality control emphasis is laid on personal inspection and supervision. Frequent visits are paid by the Central and Provincial marketing officers and others to the premises of graders, distributors and retailers. There are also elaborate arrangements for well-equipped laboratories where samples are analysed and checked under expert supervision.

Tuberculosis Association of India.—Dr. C. **Frimodt-Moller**, the first Medical Commissioner of the Association, had unfortunately to resign his appointment owing to failing health at the end of March 1942. Her Excellency the President of the Association paid a personal tribute to him at the Annual General Meeting of the Association on the 26th March in the following words:—"His knowledge of the disease, his energy, his organising ability, his missionary spirit, have been of invaluable help in the start of this Association and of the many Associations affiliated to it. His advice was sought in every part of India and his tours must have covered many hundreds of miles. He never spared himself and he inspired all those with whom he came in contact with his own enthusiasm. We as an Association will miss his guiding hand sorely and I will miss him also as a friend and as a collaborator in the work which we both have so much at heart. I know that I carry you all with me when I express to him our profound gratitude for the work he has done for India and our heartfelt wishes go with him for the recovery of his health."

Dr. Frimodt-Moller was on medical leave since the 11th of August 1941, and Dr. P. V. Benjamin, Medical Superintendent of the Union Mission Tuberculosis Sanatorium, officiated for him for about five months from the end of October last.

The affiliated Provincial and State Tuberculosis Associations have been asked to recommend names of suitable candidates for the post. The candidates are expected not only to have the necessary academic qualifications in the special subject but should also have had wide experience in both the administrative and clinical fields.

The Indian Ecological Society.—A new centre of the *Indian Ecological Society* was inaugurated at Kolhapur on Wednesday, the 15th April by Mr. S. S. Shirke, Excise Commissioner, Kolhapur State, formerly Professor of Biology, Rajaram College, Kolhapur.

Professor S. A. Parandekar, Head of the Biology Department, Rajaram College, will direct the activities of this centre.

Nagpur University.—At a meeting of the Executive Council of the University held on 1st February 1942, the following resolutions were adopted:

"....that if a student of another university leaves his university on account of war conditions and joins a college in Nagpur University within a reasonable time, the deficiency in his attendance at the lectures and practical work of his course thus resulting, should be condoned by the University provided that he has attended at least 90 per cent. of the lectures and practical work delivered and arranged since his joining the college."

The Council considered the following resolution of the Inter-University Board, India, passed at its last meeting held on the 6th and 7th January 1942, *viz.*,

"....that Universities and Boards be requested to give concessions to students who having done war services resume their studies, in the matter of the rules or regulations pertaining to age, attendance, residence and lectures generally.

"The Inter-University Board further recommends that special courses and classes be organised for the benefit of such students.

"The Inter-University Board requests the Central and Local Governments in the case of students and members of the staff of the universities who have done war service to relax the conditions of appointment in their services,"

and agreed in principle that concession on the lines indicated should be given to the students who have rendered war services.

Calcutta University.—The University has conveyed an assurance to the Registrar, Rangoon University, that the under-graduates of Rangoon University who have evacuated to their homes in India after completion of their courses of study, will receive sympathetic consideration when they apply, with proper certificates, seeking admission to the various examinations.

University of the Punjab.—The Syndicate of the University has permitted students of the University of Rangoon to appear for the examinations, privately or as college students if admitted in the colleges, in which case the deficiency in lectures might be condoned.

The Syndicate has also resolved to frame a general regulation to cover the cases of evacuees from Rangoon and from the jurisdiction of any other Indian University, authorising the Vice-Chancellor to admit them to examinations of the Punjab University on production of satisfactory evidence that the candidate was a *bona fide* student of the aforesaid Universities and would normally have been eligible to appear for an equivalent examination in his own University.

University of Madras.—The Office of the University has temporarily been shifted to Coimbatore.

Prof. K. S. Krishnan has been appointed Professor of Physics at the Allahabad University.

University of Lucknow, *Science Faculty*:—

PH.D.—The theses submitted by (1) Mr. Utsab Kumar Bose, M.SC. (Physics), "Studies in the soft X-rays with a concave grating vacuum spectrograph" and "Studies in cathodic sputtering", and (2) Mr. Ram Rakshpal, M.SC. (Zoology), "Structure and development of reproductive organs in insecta", for the degree of PH.D. have been approved.

D.Sc.—The thesis submitted by Mr. Jagdeshwari Dayal, M.SC. (Zoology), "Studies in Helminthology: Trematode parasites of fishes", has been approved.

MAGNETIC NOTES

The month of April 1942 was less disturbed than the preceding month. There were 15 *quiet* days, 12 days of *slight* and 3 days of *moderate* disturbance as against 15 quiet days, 13 days of slight disturbance and 2 of moderate disturbance during April 1941.

The day of largest disturbance during April 1942, was the 4th and that of least disturbance the 22nd. The characters of individual days was as follows:—

Quiet days	Disturbed days	
	Slight	Moderate
5–7, 9, 10, 12, 15, 20–22, 24–26, 28, 29.	1, 3, 8, 11, 13, 14, 16–19, 27, 30.	2, 4, 23.

Two moderate disturbances were recorded during the month of April 1942, as against one of similar intensity in April of last year. The mean character figure for April 1942 is 0·60 as against 0·57 for the same month of last year.

M. R. RANGASWAMI.

SEISMOLOGICAL NOTES

During the month of April 1942, one great and five slight earthquake shocks were recorded by the Colaba seismographs as against one great, five moderate, and four slight ones recorded during the same month in 1941. Details for April 1942 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T. H.	M.	Epicentral distance from Bombay (Miles)	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
March 1942							
8	Great	21	11	3160	Near Lat. 35° N., Long. 122° E. in the Yellow Sea	(Miles) About 90	
9	Slight	01	00		Apparently after shocks of the Great shock of 8th.	..	
9	Slight	05	26				
9	Slight	01	13	3110	..	..	
13	Slight	13	17	5750	..	..	
20	Slight	14	10	4070	..	About 215	

ASTRONOMICAL NOTES

The Sun will be at the summer solstice on June 22, when its north declination reaches its maximum value of 23° 27′.

Planets during June 1942.—Venus is slowly getting closer to the Sun and becoming fainter, but will still be a fairly prominent object in the eastern sky for a couple of hours before sunrise.

Mercury is too near the Sun to be well seen during the month; it will be in inferior conjunction with the Sun on June 13 and reaches a stationary point 11 days later about which time it may possibly be glimpsed low down in the eastern sky in the morning twilight. Mars continues to be visible as a second magnitude star in the western sky at about sunset; while Jupiter which will be in conjunction with the Sun on June 25 can be seen only for a few evenings in the beginning of the month, before it is lost in the evening twilight. Saturn which will have just passed into the morning sky will be still too near the Sun and will not be visible until about the end of the month. About three degrees west of Saturn is Uranus and a close conjunction of the latter with Venus occurs on June 30 (Uranus 1° 41′ North) which perhaps may be helpful to the observer in locating the planet.

T. P. B.

ANNOUNCEMENTS

Indian Statistical Institute.—In accordance with the decision of the Council of the Indian Statistical Institute, arrangements have been made to remove one portion of the Statistical Laboratory to "Amrapali", 87 Barrackpore Trunk Road, P.O., Alambazar, 24 Parganas, in the suburb of Calcutta and another portion to "Mahua", Giridih, in Bihar, about 200 miles from Calcutta, with the help of special grants sanctioned by Government for this particular purpose. The office in Calcutta at Presidency College will continue to be maintained for the present, and a branch office has been opened at "Amrapali", 87 Barrackpore Trunk Road, 24 Parganas, with effect from 15th April 1942. The Honorary Secretary expects to be able to look after the work at Giridih during the next few months, while an Assistant Secretary will be in charge of the work in Calcutta.

Biological Abstracts.—A New Section.—Section F has now been added. It comprises abstracts of Animal Production and Veterinary Science and is designed to meet the needs of men engaged in the animal industries. It will contain all of the abstracts published in the parent edition of *Biological Abstracts* that have to do with the breeding, nutrition, metabolism, husbandry, reproductive and other physiology, anatomy, pathology and parasitology, arthrapod pests of livestock, poultry and semi-domesticated animals and birds, including pet stock.

Research papers in these fields are much more widely scattered throughout the biological literature than is generally assumed. The 514 abstracts in the January issue were drawn from 135 journals. Since *Biological Abstracts* now abstracts the literature in 1,575 periodicals, subscribers to the new section will be assured a very great breadth of selection.

The new section of *Biological Abstracts* will consist of ten abstract issues per year. The annual subscription rate will be $5. Subscribers will receive the index to the complete edition of *Biological Abstracts*.

Special Tuberculosis Number of the *Indian Medical Gazette*.—At the request of the Tuberculosis Association of India, the editor of the *Indian Medical Gazette* has kindly agreed, as in the past, to publish a Special Tuberculosis Number of the *Gazette* in October this year. This will be published on the lines of previous numbers issued since the year 1937.

Articles on any aspect of tuberculosis—clinical, medical or preventive—for the forthcoming number have been invited from tuberculosis workers by the middle of July.

* * *

We acknowledge with thanks receipt of the following:—

"Journal of Agricultural Research," Vol. 64, Nos. 1-2.

"Agricultural Gazette of New South Wales," Vol. 53, Pts. 2-3.

"Annals of Biochemistry and Experimental Medicine," Vol. 2, No. 1.

"Biological Abstracts," Vol. 16, No. 1.

"Journal of Chemical Physics," Vol. 10, Nos. 1-2.

"Journal of the Indian Chemical Society," Vol. 19, No. 2.

"Experiment Station Record," Vol. 86, Nos. 1-2.

"Indian Forester," Vol. 68, No. 5.

"Transactions of the Faraday Society," Vol. 38, Pt. 1.

"Indian Farming," Vol. 3, No. 4.

"Indian Central Jute Committee (Bulletin)," Vol. 5, No. 1.

"Review of Applied Mycology," Vol. 20, Pt. 12 and Vol. 21, Pt. 1.

"Indian Medical Gazette," Vol. 77, No. 4.

Books

"Intermediate quantitative analysis," by Welch. (Oxford University Press), 1941. Pp. 128. Price 3*sh.* 6*d.*

"A manual of geometry," by N. K. Narasimha Murthy. (The Prabhat Book Depot, Bangalore City), 1942. Pp. 120. Price Rs. 1-4.

"High speed Diesel engines" with special reference to automobile and aircraft types, by Arthur W. Judge. (Chapman & Hall, London), 1941. Pp. vii + 535. Price 25*sh.*

"Economic control of iron and steel works," by F. L. Meyenberg. (Chapman & Hall, London), 1942. Pp. xx + 332. Price 25*sh.*

"Matter and energy," by V. Venkata Rao (Telugu). (Published by the Author, Maharaja's College, Vizianagram), 1942. Pp. 102. Price As. 8.

"Sound and light," by R. K. Visvanathan (Tamil) (Annamalai University), 1942. Pp. 252. Price Rs. 1-8.

"The cathode ray tube and its applications," by G. Parr. (Chapman & Hall, London), 1941. Pp. viii + 180. Price 13*sh.* 6*d.*

ACADEMIES AND SOCIETIES

Indian Academy of Sciences: *(Proceedings)*

April 1942. SECTION A.—K. S. K. IYENGAR: *Exact solution of the equations of the general cascade theory with collision loss.* G. V. L. N. MURTY AND T. R. SESHADRI: *Raman effect and hydrogen bonds, Part III. Acetic acid and its mixtures with water and phenol.* G. V. L. N. MURTY AND T. R. SESHADRI: *Raman effect and hydrogen bonds, Part IV. Mixtures of acetic acid with donor substances.* T. S. SUBBARAYA, SYED YUSUFF AND S. SRINIVASA MURTHY: *Interaction of atomic energy levels—V.* T. S. SUBBARAYA, K. SESHADRI AND N. A. NARAYANA RAO: *Interaction of atomic energy levels—VI.* P. I. ITTYERAH AND KANTILAL C. PANDYA: *The condensation of aldehydes with amides. Part X. The condensation of m- and p-nitrobenzaldehydes and 2:4-dinitrobenzaldehyde.* V. I. VAIDHIANATHAN AND CHANAN SINGH: *A new phenomenon in the movement of the free water-level in a soil and its bearing on the measurement of water-table.* When there is stratification the top layer of the soil being finer than the bottom one, a falling water-level as observed in a pipe, will begin to rise, without the addition of any water, the top of the soil being exposed to the atmosphere. This phenomenon is caused by a decrease in the pressure deficiency brought about by a flattening of the water menisci at the surface of contact of the two layers of soil. BAWA KARTAR SINGH AND BHUTNATH BHADURI: *Studies on the dependence of optical rotatory power on chemical constitution. Part XIX. Stereoisomeric aminoanilino-, and dimethylaminoanilino-, methylenecamphors, and their derivatives.*

SECTION B.—T. S. RAMAKRISHNAN: *A leaf spot disease of* Zingiber officinale *caused by* Phyllosticta zingiberi *n.sp.* GIRIJA P. MAJUMDAR: *The origin of siphonostele in three species of* Selaginella *spr.* G. D. BHALERAO: *The genus* Cephalogonimus *in India and Burma.* KHAN A. RAHMAN AND ABDUL WAHID KHAN: *Bionomics and control of* Aeolesthes holosericea *F. (Cerambycidæ: Coleoptera).* M. J. THIRUMALACHAR: Phragmotelium mysorensis, *a new rust on Indian raspberry.* B. G. L. SWAMY: *Female gametophyte and embryogeny in* Cymbidium bicolor *Lindl.* KHAN A. RAHMAN AND ABDUL WAHID KHAN: *A study of the life-history and control of* Batocera horsfieldi *Hope (Lamiidæ: Coleoptera)—A borer pest of walnut tree in the Punjab.* ABDUL HAMID: *Indian water moulds—III.* H. CHAUDHURI AND M. L. BANERJEE: *Indian water moulds—IV.* H. CHAUDHURI: *Indian water moulds—V. A new genus of the* Saprolegniaceae: Hamidia *Gen. nov.*

Mining, Geological and Metallurgical Institute of India

A recent number of the *Transactions* of the Institute (Vol. 37, Pt. 1) contains the Presidential Address delivered by Mr. W. Kirby on the occasion of the Thirty-fifth Annual Meeting of the Institute held at Calcutta sometime back. In the course of his address, Mr. Kirby has dealt with some of the major mining problems being encountered by mining men in the two major coalfields—Jharia and Raniganj—and the steps taken to mitigate the difficulties and dangers arising therefrom. The most important of these problems is that connected with spontaneous fires in these mines caused in a variety of ways and it is necessary to adopt suitable measures immediately for the prevention of these, such as are embodied in the Coal Mines Safety (Stowing) Act of 1939. There are also quite a number of other problems confronting mining men in these areas, especially as workings become deeper and more extensive, such as, ventilation in extensive gassy mines, protection of dwellings and other surface property during pillar extraction, etc. Mr. Kirby concludes: "Success in the future development of mines depends on whether or not we have made the best use of our past experience. Safe and systematic working of mines will in the end prove to be the most economical, and furthermore, our coal resources will be conserved."

The Journal also contains a paper on "An investigation into the wet concentration of the vanadium occurring in the iron ores of Mayurbhanj," which is of special interest in view of the growing importance of vanadium in the iron and steel industry. The occurrence of vanadium-bearing titaniferous iron ores in this area was recently noted by Drs. J. A. Dunn and A. K. Dey of the Geological Survey of India; and Dr. D. Swarup and V. Gopalam Iyer have now investigated the possibility of concentrating the vandium from these ores as iron vanadate, with the ultimate object of working it up as ferro-vanadium. Details of the procedure adopted have been given in the paper. The authors propose to publish in the near future the results of further experimental work which is being carried out on the manufacture of ferro-vanadium from the iron vanadate concentrate, together with a note on the direct smelting of titaniferous iron ore in the iron blast furnace.

Allahabad University—Science Colloquium, 1941-42:

The following subjects were discussed during the year. The names of those who initiated the discussion are also mentioned.

(1) Viscosity of Colloids—Dr. S. Ghosh. (2) Thermal Ionisation—Dr. B. N. Srivastava. (3) Polytropic gas spheres—Mr. H. K. Sen. (4) Magnetic Properties of Hydrated Substances—Dr. Satya Prakash. (5) Surface Waves of Earthquakes—Dr. I. D. Seth. (6) Antiresonance in Acoustics—(Miss) Chandrakanta. (7) Variable Stars and Banerji's Cepheid Theory of the Planetary System—Mr. H. K. Sen. (8) Brillouin Zone in Crystals—Prof. K. S. Krishnan.

542-42—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science", Bangalore.

CURRENT SCIENCE

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THE IDEA OF PROGRESS: EASTERN AND WESTERN

THE Western concept of progress needs to be modified at an essential point if it should not be extravagant and therefore misleading. Progress, if taken as implying continuous, uniform and illimitable improvement in our conditions of living, is nothing more than pleasant fancy-play. As improvements do certainly take place in some parts of our life and environment in consequence of the free functioning of man's will and intelligence, impairments too do as certainly set in in other parts. Seeds of the latter are as much a part of our nature as seeds of the former.

> ..... Progress is
> The law of life; man is not Man as yet.
> ..... Progress, man's distinctive mark alone,
> Not God's and not the beasts'; God is, they are,
> Man partly is and wholly hopes to be.
>
> —BROWNING

Progress or improvement may relate to either or both of two totally different things: to man's outward state and circumstance and to man himself. Not only material conditions and social environment,—wealth or poverty, health or sickness, education or ignorance, freedom or slavery, justice or inequity,—but also intellectual and æsthetic conditions must be counted as pertaining to the exterior. What makes the man himself are the postures and proclivities of his soul,—how it looks upon the objects of the senses, how it yields to or resists temptation, how it reacts to defeat or victory, how it regards life-entities other than itself. It is true that the subjective and the objective in us are closely interrelated and modify each other. But the question is—which of the two predominates. The Vedanta postulates a degree of freedom of judgment and of action for the human individual—a degree that has within itself the potency for further growth. If man uses his freedom of choice properly, his soul's emancipation

is merely a matter of time. Progress in the subjective sense is the soul's ability to control its own impulses and bring into mutual harmony the stimulii offered by the objective world and its own reactions thereto. In this sense, the progress of the world has not kept pace with the advances which science has made possible to it in realms of external existence. In the weighing and valuing of the paraphernalia of life, instead of the soul forming the fulcrum of the balance, it has become a neglected quantity in the modern world. The reason for this may partly be in that religions, which are particularly concerned about the soul, are not unanimous among themselves in their intimations and are confusing in the variety of their counsel; and further in that they have not been able to withstand the onslaughts of science. Partly it may be in that science, which began the offensive upon religion, has itself not been able to find anything positive to offer as a substitute for bringing those ministrations to man which formed the office of religion. And the new paraphernalia designed and perfected by science are so alluring and so gratifying to the bodily senses as to expel from the mind all thought of the soul. But the soul persists and is real. It is the only thing really real. Its ignoring has led to an erroneous sense of values; and in the train of that error have followed illusion and tragedy. The true foundation of the new world-order must therefore be laid in the souls of men. It is right souls that make a right world. If our effort to establish a new world-order of peace and freedom should be more successful than previous attempts in the same direction, our first business it should be to restore the soul to its sovereign place in the scheme of life. The mission of the Vedanta is to see to this.

Progress, in the sense that the conscious, conscientious and all-sided pursuit of improvement in our conditions is a duty, is undoubtedly a rational and inspiring ideal. But to assume that improvement is bound to follow uninterruptedly and without limit so as to convert our very earth on some near enough day into the Paradise celebrated by poets and prophets is to feed our minds on a false hope and to ensure ourselves endless disappointment. There is always bound to be disparity between ideal and achievement in a field where there is greater uncertainty in the material and in the instrument than in the design. Man's powers have seldom proved sufficient for man's purposes. Purposes are fashioned inside the mind and the heart; achievement depends upon external factors; and the best directed effort is often suddenly interrupted by a snag that was not till then suspected. Such is the illimitable complexity and incalculability of the forces of human nature. There is an ancient dualism in human nature—the egoistic and the bad placed in intimate association with the altruistic and the good. Man's true progress is in shedding the first and transcending the second and finally reaching a tertiary state in which there is no consciousness of either "I-ness" or "other-ness" and therefore no question of resisting either the good or the bad,—but there is only the "Oneness of All" realized in one's consciousness, and in which as a result the qualities we call goodness and kindness proceed from one spontaneously and without effort, like the breath in one's nostrils. But

this tertiary condition is only for individuals, and individuals of highly evolved natures. When that is reached, the goal of progress is reached. In other words, there is a finality practicable to the moral and spiritual progress of the individual man,—a stage of perfection when there is no more need for striving, no more seeking, no more want, no more toil. Such a man acts his part in the cosmic scheme as though it were a vast complicated play and he an appointed actor in it, and is never pained or excited at heart. To him only is there a place of rest at the end of progress. To all others, progress is a perpetual process of yearning and struggling, achieving partial improvements and suffering partial frustrations. While one set of impulses within us goes on bringing about ameliorations and felicities, another set keeps introducing deteriorations and perversities. Verily, the business of material and social progress is like repairing an ancient fort or mansion. While alterations and renovations go on in one part of the structure, sags and crevices keep on appearing in some other part. We as a race are like an old rheumatic; you may drive out the pain from the knee, it will re-appear in the ankle; you can never completely expel it from the entire body.

The Vedic seers have likened human life to an *Aswattha tree* (the Sacred Peepul, *ficus religiosa*), but an *Aswattha* growing inverted—roots up above and branches down below. The meaning of the symbol is that our life has its origin in high heavens, immortal and beyond any mortal's reach, and that it is only its temporal and spatial manifestations that move about here on earch. The word "*Aswattha*" means—"not tomorrow as it is today". It is a wonderful tree, ever-changing and yet ever-lasting. The most noteworthy fact about this long-lived tree is the juxtaposition of branches dry and decaying and branches bearing fresh shoots of golden foliage. It is growing old and growing young simultaneously. Onset of age in one part and renewal of youth in another are its normal condition. That is the story of the world's progress as well.

To discard the exaggerated part of a hope is not to abandon all hope. To admit the possibility of some conditions worsening while some others get better is not to suggest either that the idea of progress is a delusion or that human effort at improvement is a futility. Whether crowned with outward success or not, man is inwardly all the better for his effort. His will and intelligence undergo a discipline in the process, and so grows his mastery over himself and his environment. That, at any rate, is a gain, an incidental gain though it be; and a capital gain it is. This, it seems to me, is the meaning of the Gita's teaching of duty without thought of consequence,—of right deed without expectation of reward.

Progress in conditions of outward existence is certainly possible, but not perfection. Perfection is possible only in the realm of the soul, and that only after prolonged effort and evolution. And imperfections in the outward progress are of use as spurs to the inward progress.

* * *

To put the matter categorically, the message of India to the world may be said to comprise broadly three points;

(1) The recognition of an all-enveloping and all-pervasive Power in whom and through whom all beings are put in relationship with one another; whose workings reveal both cosmos and chaos, both order and caprice; who seems to uphold the law of *Karma* and yet to supplement that law by prerogative dispensations; and to whose providence all human wills and endeavours are subject.

(2) The freedom and therefore the responsibility of every man to choose and follow that line of conduct which is, rather than that which is not, in accord with his acceptance of his kinship with all living things and which therefore is in harmony with universal life. This is *Dharma*, and it implies the duty of striving to uphold justice and goodwill and to effect improvements in conditions of existence.

(3) The moderating of one's desire for material possession and sense-gratification by a constant remembrance of the naturalness of similar desires in others and of the limitedness of nature's resources within man's command as well as of the defects and perversities of human nature and, withal, of the comparative ephemerality of the things of the earth.

Practising oneness with all life, judging of right and wrong in the light of that vision of Oneness, and shaping one's relations with the world in consonance with that scale of values, restraining selfish ambition and standing up for righteousness regardless of consequence,—in one word, finding joy in renouncing the narrow separatist self and cultivating that larger self which sees its counterparts in the universe around—that is the spirit of the Vedanta. Is there not need for its infusion into relations between class and class and country and country today? Indeed, without a general acceptance of that spirit, world-reconstruction can never proceed smoothly, and the world can never come to find peace. More than any nice apportionment of the world's goods among countries and classes, more than any delicate contrivance of governance, more than the limitation of armaments and more than international pacts and treaties is the spirit in which men look upon life and its relationships. Have they persuaded themselves that life is a thing sacred and precious, lovingly and carefully to be treated? Have they come to see that promoting life for all is better than increasing life's paraphernalia for some at the expense of others? Have they learnt to prize peace above possession and justice above glory? If they have, the New World-Order of which we dream today will surely be a fact some day. But if the world will not learn the lesson, our escape can be only from one kind of chaos into another.

The characteristic difference between the Indian and the European, or the Oriental and the Occidental, as regards their attitudes towards life's problems and tasks is to be seen in how they habitually react to defeat and disappointment. Aspiration is common to both, and so is striving. Both alike plan for the right and the good, and both struggle for it with the best of their skill and strength. But when, for all that best, failure and frustration confront them, the Oriental's first thought is of an invisible

Judge who dispenses all things from above and whose scale of values and calendar of events may not coincide with his (the man's) own; whereas the Occidental's mind turns at once to find in the world around some one responsible for the mis-carrying of his plan and to deal with him suitably in the expectation that when that source of trouble is set right, the rest of the path will be smooth and easy. The Oriental does not lose his peace and balance of soul; he declines to take the defeat of the moment as the final outcome of his effort and will wait on in hope, not swerving from the good path and continuing to trust himself to the working of the higher Power. The Occidental on the other hand is thrown off his balance by impatience,—well-meant impatience though it be,—lets himself be moved to some desperate action against some one or something in the established order and insists on either mending things according to his own scheme or ending himself. Quietism comes sooner to the first, violence sooner to the second. The difference between the two is made by the part assigned by them respectively to the Superhuman in human affairs. The Hindu believes that man can never be self-sufficient and must learn to reckon with something outside of himself and his world. The European thinks that human instruments must suffice for human purposes, and if they ever fail, the fault must be looked for in the method of attack, not outside the world. The Hindu takes it as established that a certain modicum of suffering will remain to be borne here on earth, even after the very best that human intelligence and energy could achieve has been achieved. The European refuses to put up with any kind or degree of suffering as irremediable and would go on vexing himself and vexing others in his quest of a remedy.

Pushed beyond a point, both the views must prove equally pernicious, the first leading to passivity, the second to fretfulness of spirit. In a moment of tiredness of body or dimness of mind, one might easily persuade oneself that one's very best has all been done and finished, and cease further exertion in the name of submission to the will of God. There is always the possibility of one's mistaking sluggishness of intellect or of conscience for the exhaustion of one's vital sap or for the adverseness of fate, and attaching to cowardly or indolent shirking the pious label of resignation. On the other hand, there is equally the danger of one's trying to overreach oneself, forgetting that after all there is a limit to human energy and resource, and wasting oneself in a perpetual whirl of impassioned activity that can bring no peace or satisfaction either to oneself or to those among whom it is carried on. The first kind of error or delusion brings on faint-heartedness, fatalism, stagnation; the second is the road to fidgetiness of soul, to turmoil, to anarchy. Neither can mean progress.

But the two views, when not pushed to extremes, are not antithetical; and it is the task of wisdom to make a synthesis of them. Search for improvement fortified by preparedness not to chafe under such failure as may come inevitably, strive to reform society without breaking its foundations and tearing its decalogue to pieces, work with zeal and yet be resigned as to the result—such is the synthesis to be reached. Resignation should co-exist with activity. It is not after the feeling of self-

exhaustion comes that one should invoke the spirit of resignation; for, as already observed, one can never be sure when that feeling in one is well-founded and when not. Whether one is full of energy and enthusiasm or is feeling weak and hopeless, the need for submission to the Invisible Judge is always there; and equally, for the same reason, namely—that one can never be sure of the correctness of one's own self-analysis, the need for incessant exertion also is always there. "Toil unsevered from tranquillity"—that should be the motto.

> One lesson, Nature, let me learn of thee,
> One lesson which in every wind is blown;
> One lesson of two duties kept at one
> Though the loud world proclaim their enmity—
> Of toil unsevered from tranquillity!
> Of labour, that in lasting fruit outgrows
> Far noisier schemes, accomplished in repose,
> Too great for haste, too high for rivalry!

A national culture produces some distinctive intellectual or moral ethos—a faculty, a habit of mind, an ideal—which is of value to other nations. The product, if accepted, will gradually become absorbed into their life-processes and after a time lose its distinctiveness. It will afterwards be one among the various strands of international life and so a part of the world's possession. It is no longer either only oriental or only occidental; it is both, indeed universal. That great minds, being trans-national and universal, are able instinctively to reach a synthesis of the dominant notes of the East and the West is shown by the lines of Matthew Arnold above quoted.

Man's conquest, if it can be full and unqualified anywhere at all, can be so only in the inner world, over his own nature,—not in the outer world, not over cosmic nature. In the outer world, his triumphs can only be partial and qualified, because of the intractibility of other factors which are partners with him there. Complete triumph and the joy thereof can come to him, even though after ages of preparation and ordeal and self-purification, only in the inward realm, the realm of the spirit.

[From an address delivered by Mr. D. V. Gundappa to the Joint Easter Session of Science Associations in Bangalore on the 4th April 1942.]

DEVELOPMENT OF INDUSTRIES IN INDIA

"ALMOST any article can be manufactured in this country. What the country needs is a proper industrial structure and organisation backed by the Government and by the joint strength of the leaders of industry and trade or at least by one of these agencies. At the end of this war, it should probably be necessary to launch industrial schemes involving an outlay of, say, Rs. 1,000 crores or more on a five-year plan. This sum is not large, considering the vast resources of this country and the enormous size of its population.

"At the end of the war, we must plan to make our own industrial machinery with the help of machine tools freed from munition manufacture both in this country and abroad. At the end of hostilities, the belligerent nations will have considerable replacements to make for their own needs, and they will not be able to spare for us industrial machinery and shipping space to the extent that we will require. At present we should push on with the extension of machine tool-making in India."

—SIR M. VISVESVARAYA.

[From an address delivered before the first meeting of the Central Committee of the All-India Manufacturers' Organisation, Bombay.]

SPECTROSCOPIC INVESTIGATION OF THE SOLID AND LIQUID STATES

BY

SIR C. V. RAMAN

AMONGST the instruments of precision at the disposal of the physicist for the investigation of the structure of matter, the spectroscope occupies the premier position. It may be recalled that our present ideas regarding the structure of atoms and molecules are largely based on the experimental facts revealed by spectroscopy. It is scarcely to be doubted, therefore, that we have similarly to rely on spectroscopic research for an elucidation of the nature of the solid and liquid states of matter. These are not static structures in space, and even a purely geometric description of their build is, therefore, scarcely possible without the use of spectroscopic terminology. When we pass to deeper physical considerations and seek to evaluate the forces which hold together these aggregations of matter, we realise that spectroscopy gives us both the means of investigation and the language to express our results. It follows that a real knowledge of the solid and liquid states—as distinct from purely hypothetical postulates and assumptions—must rest upon a foundation of exact knowledge garnered by experimental spectroscopic research. The symposium of papers now under notice* seeks to provide such a foundation.

When we apply spectroscopy of the visible and the ultra-violet to investigations on solids, three distinct paths of research open out. These are respectively, studies on luminescence, on absorption and on the scattering of light. The case of diamond has been thoroughly investigated in all the three ways by Mr. P. G. N. Nayar and the results so far obtained are described in the two opening papers of the symposium. Nayar's work in the main furnishes a striking confirmation of the early work of Bhagavantam on light-scattering in diamond. The studies on luminescence and absorption have yielded new results of great interest. It is shown that the fundamental vibrations of the crystal lattice of diamond form a set of discrete monochromatic frequencies, of which no less than 19 have been recognised and measured. These cover the whole range of frequencies comprised in the so-called "elastic" spectrum of Debye, but their appearance as discrete frequencies with the observed distribution of intensities is a direct contradiction of the postulates on which Debye's theory of specific heat is based. Nayar also obtains the remarkable

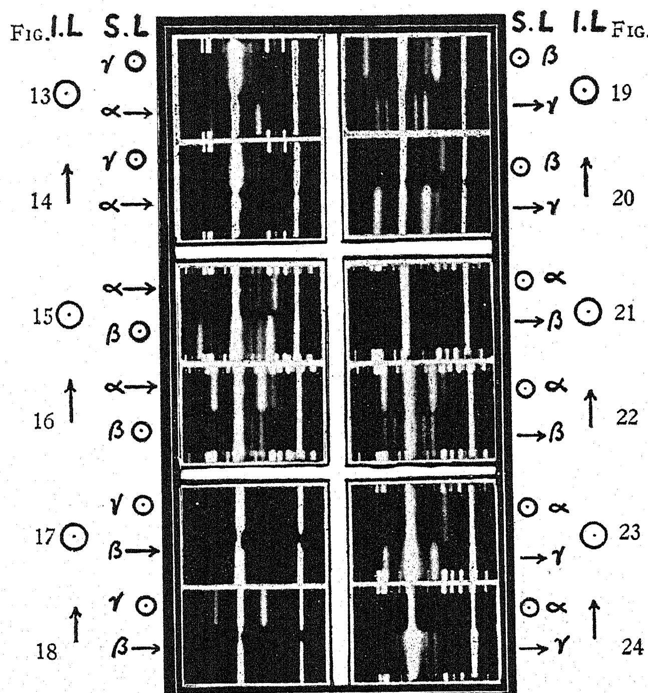

FIG. 1

Low-Frequency vibrations in a naphthalene crystal

experimental result that the electronic absorption frequencies of diamond from a set of sharply-defined frequencies at low temperatures. Some 25 of these are listed in the paper,

* Symposium of papers on Fluorescence, Light Scattering and the Raman Effect. *Proceedings of the Indian Academy of Sciences*, 'A' Series, May 1942.

Spectroscopic studies on light-scattering in crystals reveal, in addition to the so-called "internal" frequencies of vibration of the ions or molecules, if any, present in the crystal, other discrete frequencies which are usually much smaller. These appear as sharply-defined lines in the spectrum or else sharpen to such lines when the crystal is cooled down to low temperatures. The observed frequencies lie in the remotest infra-red region, and their appearance and spectral character seem irreconcilable with the ideas either of the Debye theory or of the Born crystal dynamics which demand that the vibrations of crystal lattices form *continuous* spectra. It is *prima facie* evident that these discrete low frequencies are characteristic of the crystalline state and that they play a fundamental role in all branches of crystal physics. Their identification and explanation is thus a matter of prime importance. In a very beautiful investigation from which we reproduce the accompanying illustration (Fig. 1), Mr. T. M. K. Nedungadi shows that a naphthalene crystal exhibits six such frequencies in light-scattering, instead of four as hitherto supposed. When the orientation of the crystal and the state of polarisation of the incident light are varied, the intensities of the lines alter in a remarkable way. It is deduced from these observations that

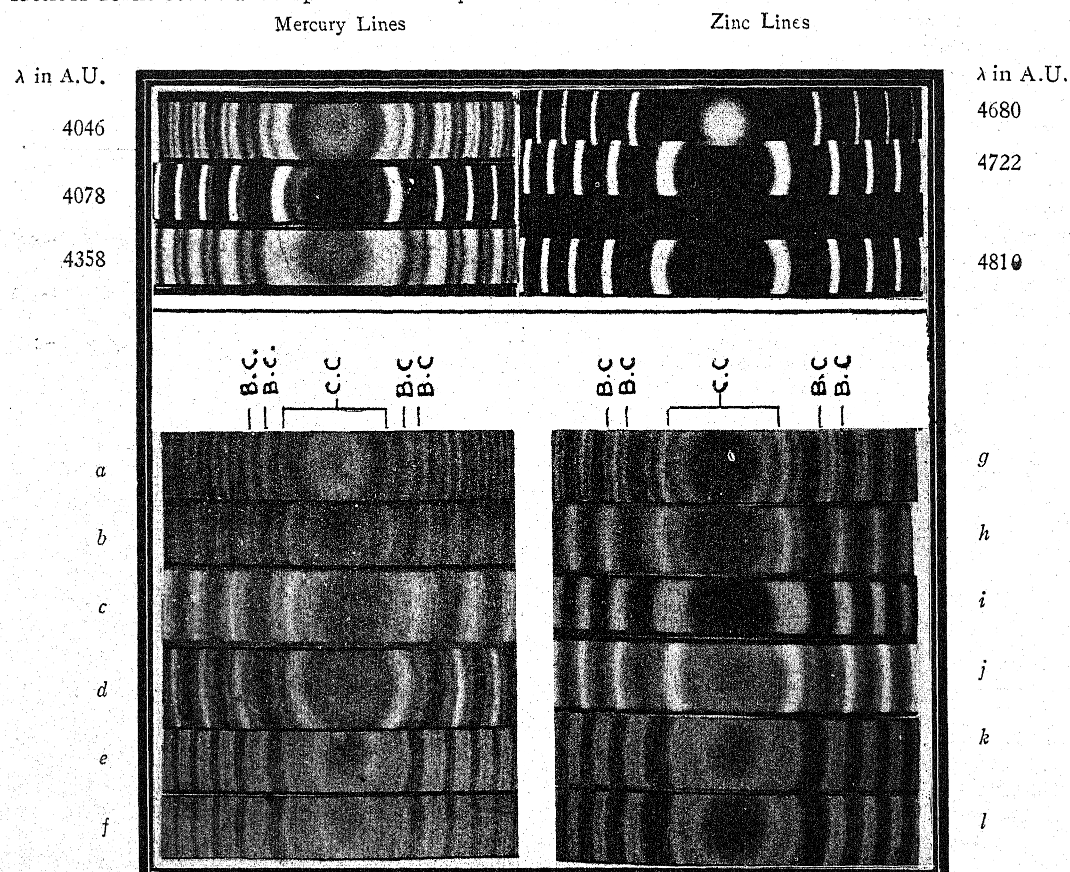

FIG. 2. Interferometer Patterns of Light Scattering in Liquids.

a. Water (30°)
b. Cyclohexane (30°)
c. Carbon tetrachloride (25°)
d. Benzene (28°)
e. Ethyl alcohol (25°)
f. Ethyl alcohol (65°)
g. Acetone (28°)
h. Acetone (54°)
i. Ethyl ether (30°)
j. Tetralin (30°)
k. *iso*-Butyric acid (25°)
l. *iso*-Butyric acid (154° C.)

the observed frequencies correspond to the six possible symmetric and antisymmetric rotational oscillations of the two molecules present in the lattice cell.

The development of a zinc-amalgam lamp giving monochromatic radiations of high intensity free from disturbing satellites has enabled Dr. C. S. Venkateswaran to carry out spectro-interferometric investigations of great value on the scattering of light in gases, liquids and solids. The perfection of his experimental technique and the thoroughness of the research has enabled results to be obtained which are trustworthy, besides being of fundamental importance. The work has also been effectively followed up by Mrs. K. Sunanda Bai. Seven out of the fifteen papers in the symposium are devoted to the work of these authors. We reproduce in Fig. 2 an illustration from one of Venkateswaran's papers.

The work of Venkateswaran and Sunanda Bai shows clearly that the conclusions reached earlier by experimenters as well as theorists in this field need radical revision. The picture of the liquid state which now emerges presents little or no resemblance to that of a crystalline solid, the analogy being rather with the amorphous or glassy state. The more viscous the liquid or the lower its temperature, the more nearly does it approximate in its behaviour to a glassy solid. This statement, in fact, covers the experimental situation as revealed by the studies on the positions and intensities of the lines in the interferometer patterns, as well as their states of polarisation.

The so-called "internal" vibrations of the molecules which become manifest in light-scattering also receive attention in the paper of Nedungadi on naphthalene mentioned above. They form the principal theme of three studies with organic liquids contributed to the symposium by Venkateswaran and Pandya. Nedungadi's work shows clearly that the selection rules for these internal vibrations are determined primarily by the symmetry of the crystal in which the molecules are imbedded and only secondarily by the symmetry of the molecules themselves. It is also evident from the investigations that even in the liquid state, the vibrations of an individual molecule are strongly influenced by those of its neighbours.

Limitations of space permit only a brief mention of B. S. Satyanarayana's paper on the relation between fluorescence and light-scattering in uranyl salts. This is a preliminary report of a very promising investigation.

THE EFFECT OF CIRCULATION UPON THE WEIGHT OF METAL CURRENCY

BY

D. D. KOSAMBI

(*Fergusson College, Poona*)

In contrast to the physical sciences, the social sciences allow, even now, the detection of quite important effects with the aid of comparatively simple apparatus and a certain amount of knowledge of modern statistical technique. The historical evidence of the demand for currency shown by the loss of weight of coins still in active circulation comes under this head. The same methods may be applied to hoards deposited in ancient times and recovered intact, thus giving the foundations of numismatics as a science.

The normal law of weight distribution may be assumed to hold for a set of coins honestly minted to a fixed legal standard in large numbers. The population mean may be taken as the supposed legal weight, the variance could be estimated by taking the number of rejections at the mint beyond the fixed "legal remedy" by which the coin is allowed to differ from legal weight. Supposing the minted weight distribution to be represented by I in Fig. 1 (and ignoring the absorption of the coinage), the effect of circulation will be to lower the mean and to increase the variance, as in II. Further circulation changes the curve to III, where only the heavier half has been drawn. Deviations from normality will become more strongly marked and the currency will tend to disappear from circulation. While the general case can be brought under the "homogeneous random process"[1] which is so

universal in application as to qualify for a law of nature, it suffices for comparatively short periods of time to take the average weight as a linear function of the date.

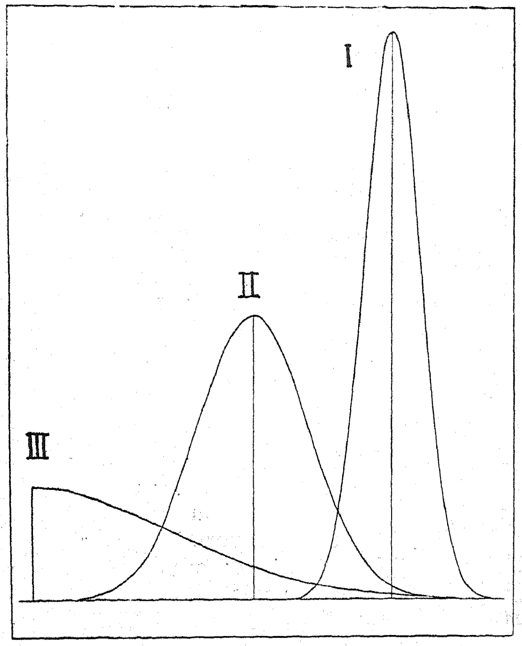

FIG. 1
Effect of circulation on weight

This theory was applied to a statistical analysis[2] of the earlier Taxila hoard (deposited *circa* 317 B.C.), but work on other ancient hoards of interest was prohibited by lack of access to the material and by the honoured custom of scattering most such material *unweighed* after a perfunctory study. So, the validity of the theory is here proved on modern coins from active circulation,[3] as a control measure. During March and April 1942, I gathered from some stores in Poona, from the great marketplace (*maṇḍai*), and when not otherwise available, from the day's take over the counter of a local bank as many specimens as my finances permitted and my energy sufficed to weigh. These were stripped of the pieces whose date was illegible, or which were severely damaged by accident, or which did not ring true for the higher denominations. Experience shows that, as regards weight, coins of the latter two classes invariably differ in a marked fashion from the rest of their annual group; for the first, there was no choice. The effect of the two latter discards is to decrease the variance within a year, so that the goodness of fit is actually reduced by this process and the theory stands confirmed even under the most unfavourable circumstances. The date on worn specimens could probably be restored by means of an examination of the crystal structure formed at the time of stamping, but I was unable to devise any method with the apparatus at hand. The pice were taken as they stood; for the other currency, modern specimens, minted in 1936 and after 1939, were in overwhelmingly large proportion, and subsamples had to be taken to reduce the numbers. The final selections were classified according to the date of the issue and each coin weighed to a tenth of a milligram. The time of the weighing was reduced by using a chainomatic analytical balance of Indian manufacture; the error of the (new) instrument was rather high—½ mgm.—but decreased with use. Proper checks were taken regularly, and the fourth place of decimals ignored in the statistical work; all means would have to be increased by half a milligram and Sheppard's corrections necessary for the variances of the data were to be used for purposes of estimation. The final stage was the statistical analysis of the weights by the methods of R. A. Fisher.[4]

With larger samples the estimates of composition and even of the actual weight and its variance would be more accurate; reliable information could be gained as to the proportion of counterfeits, mint-defective, dumb, and accidentally damaged coins in circulation. The variation between localities and local needs can also be estimated by the allocation of properly randomised samples to various regions. Finally, the residuals after fitting the regressions would be of great use in correlating the wear of various denominations to show the extent to which one type was supplementing another and enable a scientific distribution of currency to be made. Any method of currency control based on science, not on the fiat of authority, would have to consider these matters seriously. As for the weights of a large sample, the analytical balances will no longer be necessary; a histogram can be run off directly by setting the mint's automatic weighing machines in series and counting the number of coins not rejected at each step.

A look at the tables of analysis of variance shows at once that the results of

Analyses of Variance. Regressions given only where significant

Unit: one milligram; y = weight in milligrams, x = date in years

Source	d.f.	sum-square	mean sq.	F
Æ *Pies (Benares)* 1912–1939; $y - 1599\cdot55 = 1\cdot955\,(x - 1929\cdot12)$;				
regression	1	43015	43015	36·66***
deviations	23	61528	2675·13	2·28**
within a year	198	232300	1173·23	$r = 0\cdot357$
Total	222	336843	1517·31	1·29*
Æ *Pice (superseded)* 1835–1906.				
regression	1	35969	35969	$(5\cdot95)^{-1}$
deviations	27	7133371	264198·92	1·234
within a year	99	21195723	214098·21	$r = -0\cdot0356$
Total	127	28365063	223346·95	1·0432
Æ *Pice* 1907–1941; $y - 4728\cdot86 = 9\cdot903\,(x - 1928\cdot87)$				
regression	1	8574800	8574800	1663·96***
deviations	26	201108	7734·94	1·50
within a year	639	3292918	5153·24	$r = \cdot843$
Total	666	12068826	18121·36	3·516***
N *Annas* 1908–1941; $y - 3803\cdot20 = 6\cdot545\,(x - 1927\cdot70)$				
regression	1	3250147	3250147	1903·31***
deviations	26	132110	5081·15	2·975***
within a year	698	1191923	1707·63	$r = \cdot843$
Total	725	4574180	6309·21	3·695***
N 2-*Annas* 1918–1941; $y - 5759\cdot2 = 8\cdot516\,(x - 1931\cdot99)$				
regression	1	1890586	1890586	695·86***
deviations	16	71021	4438·81	1·63
within a year	315	855827	2716·91	$r = \cdot819$
Total	332	2817434	8486·25	3·12***
AR 4-*Annas* 1904–1940; $y - 2857\cdot9 = 4\cdot615\,(x - 1928\cdot098)$				
regression	1	725568	725568	459·70***
deviations	21	56104	2671·62	1·69
within a year	224	353551	1578·35	$r = \cdot799$
Total	246	1135223	4614·73	2·92***
AR 8-*Annas* 1905–1941; $y - 5764\cdot83 = 5\cdot949\,(x - 1928\cdot5)$				
regression	1	259759	259759	139·86***
deviations	21	31273	1489·19	$(1\cdot2472)^{-1}$
within a year	43	79865	1857·32	$r = \cdot837$
Total	65	370897	5706·11	3·07***
AR *Rupees*[3] 1903–1920; $y - 11579\cdot86 = 4\cdot16\,(x - 1913\cdot12)$				
regression	1	15423	15423	674·67***
deviations	16	1130	70·63	3·0898***
within a year	2868	65563	22·86	$r = \cdot433$
Total	2885	82116	28·463	
AU *Sovereigns* 1900–1931.				
regression	1	72	72	2·382
deviations	11	776	70·54	2·333*
within a year	39	1179	30·23	$r = \cdot1885$
Total	51	2027	39·745	1·315

my observations are highly favourable to the theory. Where deviations from the linear regression become significant, they are immediately explicable. The pies being not current in Poona bazaars had to be imported from Benares where they are gathered from the shops before Hindu holidays by the frugal pious, distributed to beggars, and revert to the shops immediately after. This can hardly be called active circulation; as an aside, be it noted that in places like Benares simple bits of copper can be and are still used to substitute for the lower currency: for Benares, the Butwal "pice"; almost any ancient coin in most of the purely agrarian districts of India.

The Poona pice fall into two classes, the weight of the denomination having been

materially reduced in 1907, apparently to 75 grains. In fact, all pice of my 1906 sample fall into either the 4-gram or the 6-gram group, without a single specimen of 5 grams; the mean for this year is very significantly lighter by the t-test than for previous years, heavier than for succeeding years; the variance by the z-test is significantly greater than those before or after. This seems to indicate that some of the 1906 pice were minted to the lower weight. Thus, the pre-1907 coins have been withdrawn for the greater part or have otherwise tended to disappear from circulation. Only the unworn specimens have managed to survive, whence neither the regression nor the deviations from it are of any significance. For the nickel one anna coins, the deviations from regression are caused entirely by the oldest issues: Edward VII, 1908–1910. For these, no less than 15 out of a total of 38 had illegibly worn dates, a proportion fourteen times that of the George V issues. The 23 coins retained were, naturally, heavier than the average for their groups, somewhat after the fashion of III in Fig. 1. A precisely similar effect is to be seen in the Taxilan coins of more than ten reverse marks. A recalculation of the anna data discarding the Edward VII issues immediately reduces the deviations from linear regression to insignificance, so that the deviations are to be assigned to our mechanism of selection. We can thus state a law of wear for metal currency: *For coins in active circulation, the loss of average weight is proportional to the age. But the oldest coins of a series tend to be above the regression weight and for currency not in active circulation*[6] *or an issue which is superseded, the significance of the regression tends to disappear.*

An even more striking result is that *the correlation coefficient for currency in active circulation over comparable periods of time is independent of the denomination.* Except the pies, the older pice, rupees, and sovereigns all the remaining correlation coefficients do not differ significantly from the population value of $\varrho = 0{\cdot}838$, estimated by pooling the observed values after Fisher's z transformation.[5] The correlation for the 4-anna bits is somewhat low, but there have been disturbing factors at work here: the 1917–1918 specimens show unusual wear and nickel 4-anna bits (not included in this study) were minted in 1919, 1920, 1921. In stating such a "law" for currency weights, other things must be equal: minting variances must not be great in comparison with those caused by wear, the currency must have been minted over about the same period, and must have circulated in the same locality over about the same time. As a matter of fact, 2,886 rupees of 1903–1920 issue sampled at Poona in 1940 gave me a correlation of ·43 and deviations from linearity were insufficient to explain this entirely different value. The reason for the difference, however, is very simple. It is known that r^2 is the ratio of sum square due to regression by the total sum square. Our theory requires that the variances increase with age, which means that for coins longer in circulation, the residual sum square takes up a greater proportion of the total, thus depressing the correlation. Even the pice of our sample show a correlation compatible with that of the rupees when calculated only from the 1907–1920 issues in the sample. It is a feature of the data that when the calculations are made from year to year on the basis of the weights, the correlation coefficient is found to increase steadily with the date of the last issue to its maximum value at the end; this holds for all denominations provided the oldest issues do not contain overweight survivors in large proportion and the regression is really significant.

Whereas the samples show that the variances are in general decidedly greater for the older issues, the samples do not allow the question of linear increase of the variance with age to be effectively discussed except for the post-1906 pice. The only method I can see that would test this would be (1) to calculate the linear regression from the sample variances, giving each the weight of its degrees of freedom, (2) apply the χ^2 test, noting that the ratio of the observed to a hypothetical variance should be distributed as χ^2/n. From the total number of degrees of freedom, two have to be subtracted for the fitting. The pice variances only, when all are tested by this method, show linear increase with age; on the whole, the pice are statistically the most satisfactory denomination—in spite of evidence of heavy corrosion of three specimens by fatty acids—because no one rings them, counterfeits and hoarding are absent, change of hands regular.

Brass ½ annas, annas, and two annas of

1942 issue just reached circulation at the time of the study, so that no disturbing effect was obvious on the rest of the currency, whatever the future may show. The data gives: ½ annas—$n = 53$, $m = 2{\cdot}9125$ gm. $s^2 = 786{\cdot}88$ mgm.^{2}; annas—$n = 38$, $m = 3{\cdot}8851$ gm., $s^2 = 3934{\cdot}51$ mgm.^{2}; 2 annas—$n = 22$, $m = 5{\cdot}8023$ gm., $s = 7773{\cdot}6$ mgm.^{2} The two last fit very well into their respective lines of regression and analysis of variance. It is not likely that the debasement will cause any disturbance due to hoarding, though the rate of wear will naturally change. For, the silver alloy had already changed nearly three years ago from 11/12 to 6/12 fine; even the nickel of Geogre VI appears to differ from the older composition. Even with the pure metal used for each denomination, including the rupee, the currency would have a value of metal well below its denomination, hence the change to brass only emphasizes the most universal of all numismatic laws, the inevitable trend towards debasement in times of stress. For our purpose there is a far more serious effect visible in the samples. The minting since 1939 shows a decided increase in variance, and the occurrence of overweight specimens shows that the old legal remedy (from 1/40 for copper to 1/200 for silver) has been relaxed in practice, whatever the law at present. If this tendency was present in the coins struck during the last Great War (1914–1918), or during the depression years, it is certain to upset the linearity of variance increase, without affecting the law for mean weights. Whether the tendency towards cruder striking of the coins with regard to weight is manifested in other countries and periods before great changes of structure will also have to be studied with this example in mind.

I am grateful to the kind friends who saved me much of the labour of gathering the samples in an unusually hot summer. Special thanks are due to my geological colleague Prof. K. V. Kelkar for going out of his way to place the facilities of his laboratory at my disposal.

1 A. Kolmogoroff, *Math. Annalen*, 1931, **104**, 415–458.

2 D. D. Kosambi. *New Indian Antiquary*, 1941, **4**, 1, 49.

3 ————, *Current Science*, 1941, **10**, 372.

4 R. A. Fisher, *Statistical Methods for Research Workers* [7th ed.], ex. 42.

5 *Ibid.*, ex. 33.

6 The gold sovereigns have had almost no circulation, but if just two more specimens, dated 1887, 1897 (and used regularly for worship) are added to the sample accepted, the correlation takes the very highly significant value of ·64, with very highly significant deviations from regression.

AN UNUSUALLY LONG-LIVED DUST DEVIL AT POONA ON THE 27th MARCH 1942

BY

P. K. RAMAN

(*Agricultural Meteorology Section, Meteorological Office, Poona*)

A DUST devil was observed to persist from about 12·00 hrs. to 15·45 hrs. I.S.T. near the Central Agricultural Meteorological Observatory at Poona on the 27th March 1942. Fig. 1 shows a map of Poona and its environs; the track of the dust devil is shown by the dotted line. On the right hand side may be seen the confluence of the two rivers Mutha and Mula. 'O' is the position of the Observatory from which the dust devil was continuously under observation. The position of the dust devil at different times during its unusually long life is indicated by the letters A, B, C, D and E in Fig. 1.

At 12 noon the dust devil appeared at the point A. Its diameter was apparently about 20 to 30 ft. and its top at an elevation of about 20° to 25°. During the interval 12·00 hrs. to 14·45 hrs. the dust devil moved very slowly from the point A to the point B which is about two miles due north of the Observatory. During its passage from A to B, a distance of two miles *across* the line of sight, the dust devil might have moved slightly at intervals *along* the line

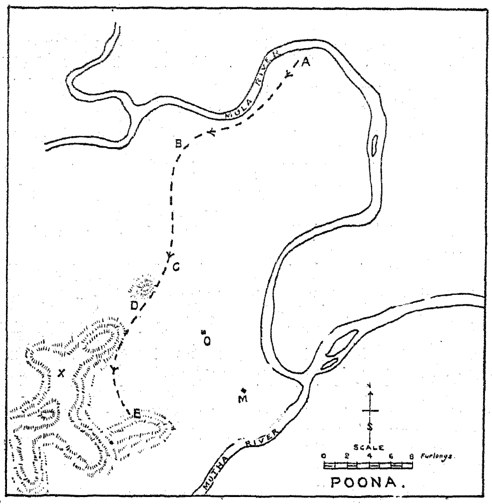

FIG. 1

of sight, but it was not possible to make any correct estimate of such movements. As it approached the position B the base of the dust devil appeared very much like a dark pillar of smoke rising out of a fire. Later, it was verified that at this point dust from a coal dump was caught up by the whirl-wind. The appearance of the dust devil during the stage AB is shown by the photographs *a, b, c, d, e* and *f* respectively taken at the time intervals indicated in Fig. 2. At about 3 p.m., while watching from the 35 ft. tower at the Observatory the dust devil was seen suddenly to gain in momentum and to move faster than before in a southerly direction. By now, the colour had changed from dark to the usual brown colour. The elevation of the top of the dust devil was now as much as about 70° above the horizon. The upper portion had also spread out, obscuring the sun for nearly 15 minutes (Fig. 2, *g*). The whirl-wind now rapidly moved in a southerly direction towards the point C. While near C, a huge galvanised iron sheet was seen to be torn off from the roof of a temporary shed. Soon after, this sheet came down and hit the ground with a loud noise. Tiles from other neighbouring sheds were also seen to fly up and fall to the ground. The whirl was now at its minimum distance from the Observatory with its direction of rotation clock-wise (Fig. 2, *h, i*). Then the dust whirl moved towards the hill, marked D in Fig. 1. At this place the whirl was about 40 to 50 ft. in diameter. It then split temporarily into two distinct whirls but later fused again into a single whirl with its fury slightly abated (Fig. 2, *j, k, l*).

Afterwards the whirl moved from the position D to the position E near the Fergusson College along the foot of the hill marked X in Fig. 1. The dust devil was visible till about 15·45 hrs. when it appeared to die out somewhere near the point marked E on the map.

An estimate of the height of the dust devil may be made from (*i*) the horizontal distances from the point of observations measured with the help of a big map of Poona and (*ii*) the altitude or the vertical angle of the top of the revolving column. Table I gives the approximate location, horizontal distance from the Observatory, angle subtended and the estimated height of the dust whirl in feet assuming that the "devil" was vertical. As the upper wind direction was from NNE, *i.e.*, from the "devil" towards the observer, the height calculated is likely to be an overestimate especially when the distance was small.

TABLE I

Approximate location as given in Fig. 1	Horizontal distance from the Observatory	Angle subtended	Estimated height in feet
A	24 to 30 fur.	20°	5200–5900
B	16 to 18 fur.	30°	6000–6900
C	9 furlongs	60°	9900
D	6 furlongs	70°	10600

Table II gives the temperatures observed with an Assmann Psychrometer at about 13·30 hrs. on the 27th March in the "open" at the Central Agricultural Meteorological Observatory. Lapse rates calculated from these observations are also given in the table.

Fig. 3 is a reproduction of the Dines Pressure Tube anemogram recorded at the top of the 120 ft. tower of the Meteorological Office marked M in Fig. 1. During the interval 10·00 to 16·30 hrs. the air movements were more or less of the thermal

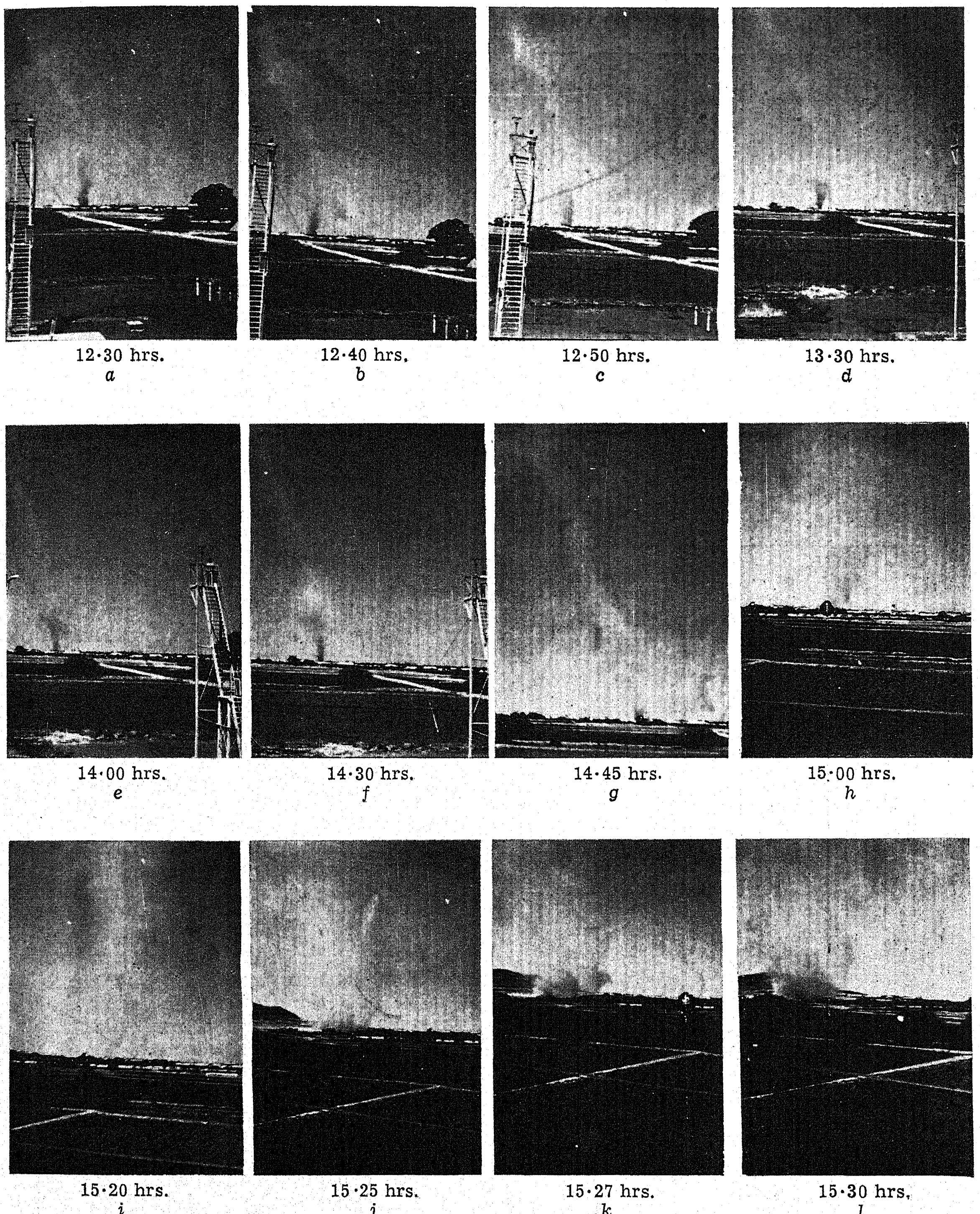
12·30 hrs.
a
12·40 hrs.
b
12·50 hrs.
c
13·30 hrs.
d
14·00 hrs.
e
14·30 hrs.
f
14·45 hrs.
g
15·00 hrs.
h
15·20 hrs.
i
15·25 hrs.
j
15·27 hrs.
k
15·30 hrs.
l

FIG. 2

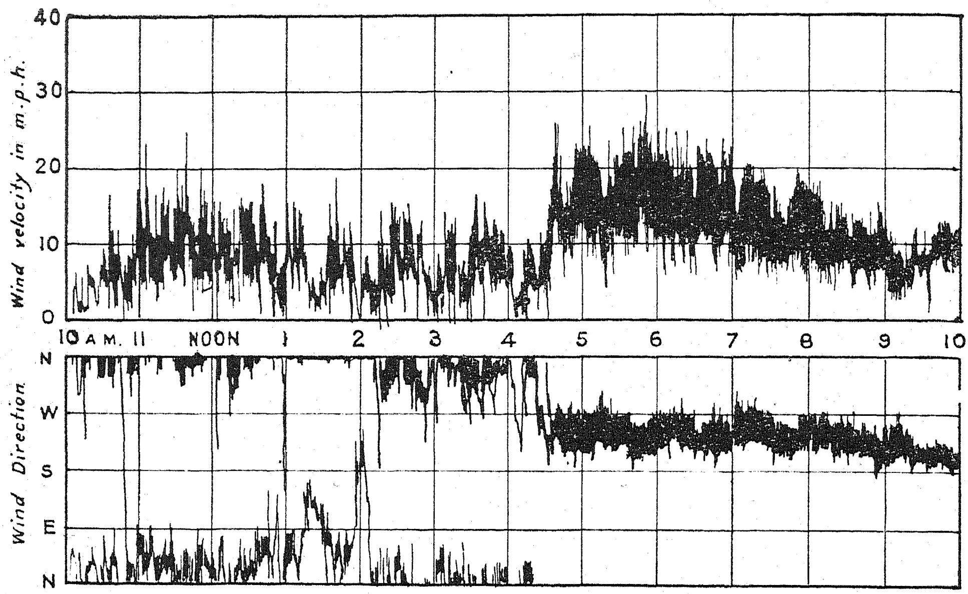

FIG. 3

TABLE II

Height in cm. above ground	Temperature in °C.	Lapse rates expressed as number of times the adiabatic lapse rate [0·987°C.(1°C. approx.) per 100 m.]
Surface	69·0	
		218000
1·0	47·2	
		13000
2·5	45·2	
		4400
7·5	43·0	
		1330
15	42·0	
		130
30	41·8	
		330
60	40·8	
		—
90	41·0	
		—
120	40·8	
		67
180	40·4	
		100
240	39·0	
		50
300	38·7	
		—
450	38·7	
		40
600	38·1	
		—
750	38·1	
		—
900	38·1	
		13
1050	37·9	

convective type with a northeast to southeast direction and comparatively low velocity (5 to 10 m.p.h.). We have already indicated in Table II the extremely high lapse rates in the air layers near the ground. The dust devil was in the convective layer throughout its life. The pilot balloon let off at the Meteorological Office in the afternoon indicated a rate of ascent of the order of 10·5 km./hr. while that indicated by the free lift of the balloon was only 9·0 km./hr. From Fig. 3 it will be seen that at 16·30 hrs. a strong sea breeze from a west-southwesterly direction set in.

The wind velocity at the Meteorological Office Tower from noon to 4 p.m., before the westerly sea breeze set in, was of the order of 5 to 10 miles per hour. The pilot balloon observation on the same afternoon indicated that the wind direction and velocity upto about 2 km. were approximately NNE and 10 miles per hour respectively. Thus although the general drift of the dust whirl was in the same direction as that of the wind upto 2 km., its velocity was only 1/10 to 1/5 of the mean wind velocity, which is surprisingly small.

A detailed study of dust devils is being made at the Central Agricultural Meteorological Observatory where conditions are favourable for observation and correlation with the other meteorological factors. A detailed report of the work done during this summer will be presented later on.

OBITUARIES

RAI BAHADUR SARAT CHANDRA ROY (1871–1942)

SARAT CHANDRA ROY was born at Calcutta and was educated for the legal profession which he entered in 1897. Early in his career Roy was struck by the amount of injustice done to tribal people, in spite of best intentions, by judges and magistrates and police officers of all grades who depended upon touts and interpreters while their ignorance of the tribal language and culture often proved an insuperable barrier to any understanding of the tribal point of view. With a strong determination to serve the tribal people, Roy learnt the language of the Mundas and through it, he recorded the various details of their tribal organisation, economic life, laws of succession and inheritance and their religious life. The publication of *The Mundas and their Country* in 1912 distinguished Roy as an authority on the Mundas and the young lawyer-scientist was now encouraged by the administration of Bihar and Orissa to pursue his investigations. With the financial help given him by the Government from time to time, he published several monographs on the tribes of Chotanagpur and adjacent areas. His monograph on the Oraons was published in 1916, that on the Birhors in 1925 and the Oraon Religion and Customs in the year 1928. In 1935, he published his monograph on the Hill Bhuiyas of Orissa and two years later, in collaboration with his son, Mr. R. C. Roy, whom he had trained up in the methods of field investigation, he published two sumptuous volumes on the Kharias, a little-known jungle tribe of Chotanagpur, Central Provinces and Orissa. Dr. R. R. Marett who wrote a brilliant introduction to this work, described it as a 'model how such research should be conducted'.

With a facile pen and a literary style Roy enlarged his scope of studies. In the Bihar and Orissa Research Society's Journal, he opened up new ground on the archæology of his Province. He has explored many pre-historic sites in Chotanagpur of what are locally known as 'Asur' sites. Although he did not find any human remains from these sites, the stone implements polished and otherwise, cornelia beads, wheel-made pottery, copper and bronze tools and implements, cinerary urns, phallic symbols and such other objects were dug out in plenty and have made the Patna Museum a rich store of pre-historic antiquities. His own house at Ranchi is a rich museum of rare specimens which give inspiration for antiquarian research to local students and inquisitive visitors. Roy's knowledge of physical anthropology was admirably outlined in his Patna Readership Lectures and later on published as 'Principles and Methods of Physical Anthropology', a brilliant exposition which has elicited unstinted praise from experts.

Students of Indian anthropology are deeply indebted to Mr. Roy for the light he has thrown on the past and present culture of the Chotanagpur plateau. He has played a most distinguished role in the development of anthropological thought in India, and had greatly advanced the science of man and its popularity. Roy was never tired of reiterating the importance of anthropological studies in India. The indifference to anthropological studies displayed by the administration and the public bodies is a regrettable chapter of Indian education. Towards the later years of his life Roy emphasised the practical value of anthropology in the promotion of human welfare. He has indicated how a systematic study of the social organisation and religious system, customs, habits and mentality of the people was a necessary preliminary to a satisfactory solution of the special, economic, social and political problems. The study of men of different races and religions, of the customs and manners of one another may help in promoting mutual amity and knitting more closely the bonds of unity between them and thus eventually help to banish much of the communal animosity which is the bane of Indian national life at the present day. Deeply religious as he was, Roy believed that with the realisation of the essential unity of *homo sapiens* which a scientific study of man reveals, the powers of Life, Light and Love would triumph over those of Death, Darkness and Discard and convert our earth into a 'warless creed, a single race and a single tongue'. To this end he worked and towards the end of his career, a significant

change in his anthropological outlook took place and he veered more and more to the functional standpoint.

Roy died ripe in years and rich with honours. A week before his death, a Volume of Essays was presented to him by the well-known anthropologists of India as a token of their grateful recognition of his services to the cause of Indian anthropology. In 1920, he was elected an Honorary Fellow of the Folklore Society of London. He was elected President of the Anthropology Section of the Indian Science Congress for the year 1920 and the President of the section of Anthropology and Folklore of the All-India Oriental Conference in 1932 and again in 1933. He was a foundation-Fellow of the National Institute of Sciences in India and also a member of the Senate of the Patna University. For more than two decades, Roy had edited the Quarterly Journal of Anthropology, *Man in India.* In 1913, he was awarded the Kaiser-i-Hind Medal for literary and public services and the title of Rai Bahadur was conferred on him in 1919. He represented the aboriginese of the Ranchi District for successive terms in the Bihar and Orissa Legislative Council and was a member of the Provincial Committee that sat with the Indian Statutory (Simon) Commission and also the Indian Franchise Committee (Lothian Committee). On the 30th of April 1942, ended the useful career of this distinguished scientist whose researches have raised the status of Indian anthropology and have ensured him great fame in its annals.

D. N. M.

MR. M. VENKATANARANAPPA

IT is with deep regret that we record the death of Mr. M. Venkatanaranappa, Chairman, Mysore Iron and Steel Works, on Saturday, the 30th May 1942, at his residence in Bangalore. Mr. Venkatanaranappa, apparently in good health, was at work and carried through his normal round of engagements even on the day prior to his demise and his passing away, quietly in his sleep, of heart failure, came as a great shock to his relatives and a wide circle of friends.

Mr. Venkatanaranappa who came of an old Mysore family settled on land in the Kadur District was born in 1891; after his early education at Chickmagalur, he graduated from the Christian College, Madras, securing a first in English. He then joined the Madras Law College but before taking a Law degree, Mr. Venkatanaranappa won the second place in the competitive examination of the Mysore Civil Service which he entered as a probationer in 1914. He had the normal service career of a Civil servant till 1921 when he was selected for being trained in the administrative and accounts section at the Tata Iron Works, Jamshedpur. On his return, he was posted as Accountant at the Mysore Iron Works, Bhadravati, which had just been born and which, in the eyes of its critics, looked none too robust an infant. Thus began Mr. Venkatanaranappa's association with Mysore industrial enterprise—an association which during the next twenty years was productive of such fruitful results. Mr. Venkatanaranappa was later appointed General Manager at Bhadravati till 1934 when he became Development Secretary to Government, and during the succeeding five crowded years, Mr. Venkatanaranappa was intimately associated with the launching of several new concerns in the State for the manufacture of steel, chemicals, paper, cement, silk, ferro-alloys, implements, matches, machine tools, etc., and for further developing other industries already established. In 1939 he became the Chairman of the Mysore Iron and Steel Works. He was also associated with a number of other concerns either as Chairman, or Director. He took a leading part in the negotiations preceding the formation of the Hindustan Aircraft Ltd., on whose Board he represented the interests of the Mysore Government. He also represented the State at a number of Conferences convened by the Government of India on industrial matters and notably at the Eastern Group Conference for gearing industrial effort to war needs.

Thus, although Mr. Venkatanaranappa was intimately associated with many of Mysore's industrial enterprises, some of which he helped to bring into being, his name will be long and specially associated with the Mysore Iron and Steel Works to which he devoted the best part of his life. He was one of the pioneers who nursed this great enterprise through its rather delicate infancy, and its teething troubles on to its vigorous and promising manhood. It looked as though the Works would be closed before they had a chance to be properly born, so to speak.. Mr. Venkatanaranappa was

amongst those who saw clearly that more than the mere future of the Iron Works was at stake and the acceptance of failure meant that the very industrial policy of the State would be challenged and all industrial enterprise stifled for many years to come. It is not easy now to appreciate the hurdles that had to be cleared in the first years; technical difficulties, the normal concomitant of any big and new enterprise especially as the experiment of running a blast furnace on charcoal was unique in this part of the world; others again, like the economic collapse the world over, following the last War which hit all industries and all countries alike and over which Mysore had, naturally, no control; and, finally, and perhaps the most difficult to bear, was the criticism, sometimes very strong and often ill-informed, which was levelled at the Works by public opinion in the State which as yet had no experience of the running of heavy basic industries. When the early years did not bring the financial results that were almost taken for granted, impatient criticism gave place to almost a clamour for closing down the Works and in those dark days, Mr. Venkatanaranappa ranged himself on the side of those who with vision, robust optimism and uncommon courage, insisted on carrying through the enterprise in the larger interests of the State. Mr. Venkatanaranappa happily lived to see this confidence justified.

Although Mr. Venkatanaranappa had no formal training in science at his University, he was a votary of science, who believed and practised in scientific method and research. He was a voracious reader and this wide reading coupled with the knowledge he gained in the hard school of experience gave him an intimate knowledge of the many industries he was connected with. Moreover, he believed, long before it was the fashion to do so, in industrialisation and in the capacity of his fellow-countrymen to organise and run industrial enterprises. Many were the schemes of research he initiated at Bhadravati and many were the young men of science whom he started on useful careers. He actually showed what could be done even under the undoubted handicaps of which he was only too well aware of. All these traits won for him the confidence not only of Government but of Indian industry, several of whose leaders all over the country were his personal friends. And no one could wish for a kinder, more generous or more loyal friend; sensitive, witty and brilliant in conversation he also had a rare sense of humour. Indeed, no one laughed more merrily than he when the facetious made obvious jokes at this gentleman of generous proportions being connected with the Development Department and the heavy industries.

Mr. Venkatanaranappa died in harness. His untimely death terminated a career which with the solid achievements behind it, held promise of even greater usefulness to the State. A large number of friends and admirers mourn the loss of a gentleman whose name is woven into the warp and woof of the pattern that is and that will be for some years to come of Mysore's industrial enterprise.

MR. M. SESHA IYENGAR, M.A.

IT is with deep regret that we record the death of Mr. M. Sesha Iyengar on the 30th of May 1942 at Bangalore. Mr. Sesha Iyengar was born in 1891 and after graduating from the Central College, joined the teaching staff of the Chemistry Department of the College in 1914. His remarkable administrative capacity was duly recognized when in 1928, with the starting of the Intermediate Colleges, he was appointed the Superintendent of the College at Bangalore —an institution of over a thousand students. He held this post, which carried with it the status of a Professor, till his death.

Mr. Sesha Iyengar was prominently associated with the teaching of chemistry at the Central College and was recognized to be a very capable teacher. Though his administrative duties took up most of his time, he was keenly interested in research —his main contribution being a Study of Substitution in Resorcinol Derivatives.

Mr. Sesha Iyengar was always enthusiastic about sports. As an undergraduate he played football. Later, he was keen about tennis, in which he won several trophies— the last, barely three months before his death.

By his death, the Mysore University has lost a capable teacher and a very efficient administrator. B. S.

LETTERS TO THE EDITOR

CONSTITUTION OF ANOLOBINE

In a previous communication[1] the synthesis of *dl*-2, methoxy-5, 6, methylene dioxy- nor-aporphine was announced. Since then small amounts of anolobine (60 mg.) and anolobine O-methyl ether (30 mg.) have been received from Dr. Manske of the National Research Laboratories, Canada. The synthetic base being racemic was unsuitable for direct comparison with anolobine O-methyl ether which is lævo-rotatory. Racemisation of the natural alkaloid was not feasible as the amount available was too small for the process to be successfully carried out. The yield of *dl*-2, methoxy-5, 6, methylene dicxy- nor-aporphine from 2, amino-5 methoxy-6, 7, methylene dioxy, 1, 2, 3, 4, tetrahydro-isoquinoline through the Pschorr reaction was only about 5 per cent, and a sufficient amount of the aporphine could not therefore be accumulated to attempt a resolution of the optically inactive synthetic base.

Recourse was therefore had to the elegant method of Gadamer[3] in which, by treating both the synthetic and the natural bases with ethyl chloro-carbonate and alkali, products were obtained in which the nitrogen ring was cleaved and the centre of asymmetry destroyed. Both these products, being optically inactive, become comparable.

The synthetic base on treatment with ethyl chloro-carbonate and alkali yielded a solid which, after two crystallisations from alcohol and a third from 50 per cent acetic acid, melted at 169-170° C. (Prisms).

By a similar treatment with ethyl chloro-carbonate and alkali, Manske's anolobine O-methyl ether yielded a solid which, after three crystallisations (the last from 50 per cent acetic acid), melted at 245-247° C. (colourless sheaves of long needles).

The two products when mixed melted to a clear liquid between 220-230° C. after shrinking to a tiny dot at 160° C.

It appears therefore that anolobine cannot be represented by the structure assigned to it by Manske.[2]

My grateful thanks are due to Dr. Manske for his gift of anolobine and anolobine O-methyl ether and to Professor B. B. Dey for his guidance and keen interest in the work. Full details of this investigation will be published in due course elsewhere.

T. R. Govindachari.

Presidency College,
Madras,
May 30, 1942.

1 Govindachari, *Curr. Sci.*, 1941, **10**, 76.
2 Manske, *Can. J. Res.*, 1938, **16**, 76.
3 Gadamer, *Arch. Pharm.*, **259**, 146.

TOXICITY OF MUSTARD OIL SAMPLES PREPARED FROM MUSTARD SEEDS AND CAKES UNDERGOING MICROBIAL DECOMPOSITION

IN a recent communication the present author[1] reported that it was possible to prepare mustard oil samples from argemone-free mustard seeds and cakes undergoing microbial decomposition, resembling in physical and chemical properties samples of mustard oil reputed to have produced symptoms of epidemic dropsy in man. He[2] has also shown that three proved potent samples of mustard oil obtained from Lal did not contain argemone oil—the causative factor suggested by Lal, Chopra and others—even in a concentration of 0·75 per cent.

However, if the microbial decomposition theory be correct then the oil samples prepared from decomposed mustard seeds and cakes should, in the first instance, prove toxic to animals. With this end in view some feeding experiments were carried out and a summary of the effects observed is given here.

Twelve growing albino rats were used, nine in the experimental series and three in the control group. The experimental rats were given a daily dose of mustard oil both expressed and extracted from fungus-decomposed mustard seeds and cakes whereas the control ones received equal amounts of pure 'ghani' mustard oil. The animals in the experimental group showed very soon a sickly appearance with considerable loss of fur and subsequent loss in body weight. Of the nine animals, six died and three killed at intervals to study the progressive changes in tissues, if any. The control animals behaved in a more or less normal manner and there was a gradual increase in body weight. One control rat while maintaining a good growth suddenly developed peritonitis with intestinal obstruction and died on the fiftieth day. The other control rats were killed at intervals to serve as standards for comparison.

The heavy mortality in the experimental group coupled with definite histological changes in some tissues of these animals reported by Sen (elsewhere in this issue) indicates that mustard oil samples prepared from decomposed mustard seeds and cakes are fairly toxic. In this connection some findings of Lal appear to be very significant. While experimenting with rats he and his co-workers[3] observed that 'a supply of mustard oil, which had been incriminated on epidemiological grounds, proved *toxic* to rats in as much as *it caused reduction in weight and early death*'. In the case of cats they[4] observed that *in 5 per cent. argemone oil group none died whereas there was heavy mortality in the Rangpur oil group (dropsy-positive mustard oil) and five out of six cats died.* Full details of the present investigation will be published elsewhere.

My best thanks are due to Dr. T. N. Sen, M.B., for kindly carrying out the post-mortem and histological examinations. I am also grateful to Prof. S. N. Bose, F.N.I., and Prof. J. K. Chowdhury, F.N.I., for their kind interest.

S. N. SARKAR.

Biochemical Laboratory,
University of Dacca,
June 3, 1942.

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1 Sarkar, *Ann. Biochem. Exp. Med.*, 1941, **1**, 325.
2 —, *Ibid.*, 1941, **1**, 271.
3 Lal, et al., *Ind. Jour. Med. Res.*, 1941, **29**, 168.
4 —, *Ibid.*, 1941, **29**, 183.

POST-MORTEM AND HISTOLOGICAL CHANGES IN SOME TISSUES OF RATS FED ON MUSTARD OIL SAMPLES PREPARED FROM MUSTARD SEEDS AND CAKES UNDERGOING MICROBIAL DECOMPOSITION

ON the suggestion of Dr. S. N. Sarkar, post-mortem and histological examinations of various tissues of animals subjected to his mustard oil tests were carried out by me and the important changes noticed are summarised below.

Morbid Anatomy.—The liver showed marked congestion in all the experimental animals and in a few cases, some hæmorrhagic spots or patches were noticed. In the control series very slight congestion of liver was observed.

Congestion of lungs in varying degree was present in all the experimental rats. In one

case a solidified patch, whitish in colour, was observed at the lower pole of the lower lobe of each lung. While sectioning through these solidified patches a thick whitish gelatinous matter came out. Very little congestion was noticed in the control series.

In the heart of the experimental animals, the ventricles were all empty and the auricles (specially the right), the superior vena cava and the inferior vena cava were distended with accumulation of dark blood. In some, the coronary blood vessels were somewhat engorged. In one case there were also some sub-pericardial hæmorrhages. The control series, however, showed no appreciable change.

In the experimental series no noticeable change in kidney in earlier stages could be seen but in later stages it showed some congestion. In the control series there was practically no change.

In the spleen of the experimental animals slight congestion could be noticed in later stages whereas in the control group no such change could be noticed.

The skin in some of the experimental animals was studied and the blood vessels of the ear appeared to be a bit more prominent than those in the control series. In the abdominal skin the cutaneous blood vessels could not properly be examined due to the part being thickly covered with hair.

One control rat which unexpectedly died showed much congestion of the intestines with some unstained peritoneal fluid and intestinal obstruction in the lower part of the ileum. The intestinal coils above the site of obstruction showed undue distension of the gut. As this rat died of some intercurrent disease so the changes in different organs were not taken into consideration.

Morbid Histology.—The liver in all the experimental animals showed considerable dilatation and engorgement of the sinusoids, central intralobular vein and branches of portal vein. In some cases the liver showed degenerative changes also. In the control series, the liver, in some cases, showed slight congestion but it was practically negligible in comparison with that of the experimental series. The extravagation of blood was not noticed in any case and the hæmorrhagic areas in the morbid anatomical examination were due to extreme vascular dilatation.

Lungs in all the experimental animals showed dilatation and engorgement of alveolar capillaries with blood and cellular exudate and in one some granular exudate with a few cells in the alveolar spaces thus obliterating and filling up partially or completely some of them. In two cases lungs showed marked congestion with blood and leucocytes infiltration resulting in many of the alveoli being completely blocked with red blood corpuscles and white blood corpuscles. In the control series no such marked changes could be noticed.

In the experimental series the heart showed some engorgement of vessels in between the muscle fibres. In one case the section showed some engorged dilated vessels in sub-pericardial tissue. In the control series no pronounced change was noticeable.

The kidney in the experimental rats showed very little or no congestion of the glomerular capillaries at earlier stage of the experiment but in later stages it showed definite and marked congestion of glomerular and intertubular capillaries. In the control series, however, very slight glomerular congestion, if at all, could be noticed.

In the spleen of the experimental rats some degree of congestion was noticed at a later stage whereas in the control ones no such change was observed.

In the skin of some of the experimental animals there was some degree of vascularisation of the corium with young dilated capillaries and perivascular infiltration in some cases. In one where the abdominal skin was examined some engorged blood capillaries in the subcutaneous fatty tissue were observed. In the skin of the control series no marked vascularisation was present.

These findings together with the result of feeding experiments reported by Sarkar (elsewhere in this issue) suggest that mustard oil samples obtained from mustard seeds and

cakes undergoing microbial decomposition are definitely toxic. Full details will be presented elsewhere.

My best thanks are due to Dr. S. N. Sarkar for kindly supplying the materials used in this investigation. I am also grateful to Prof. S. N. Bose, F.N.I., and Prof. J. K. Chowdhuri, F.N.I., for their kind interest.

T. N. SEN.

Physiological Laboratory,
University of Dacca,
June 3, 1942.

NON-HERITABLE POLYEMBRYONY IN *ANDROPOGON SORGHUM*

THE reported cases of polyembryony in crop plants fall into two groups, those in which the character is inherited as instanced in the case of citrus,[1] rice,[2] cotton,[3] etc., and others in which it is not hereditary.

The following is an example of the non-hereditary type of twinning observed in *Sorghum*. For the past seven years annually a few thousand seedlings of *Sorghum* of the *bilichigan* and other varieties have been raised individually in enamel dishes in connection with an investigation on *Striga* attack on *Sorghum*. On three occasions twin seedlings were obtained from individual seeds. In each of the three cases one of the two embryos developed into a seedling, which was bigger and more vigorous than the other seedling. The root systems of the two corresponded in vigour with their aerial parts; the roots of the weaker of the twins was slenderer and less branched (Fig. 1). Of the three twins one was accidentally destroyed, while in another the twin seedlings were planted separately and grew for some time and then both died. Both seedlings of the third grew to maturity and observations on this forms the subject of the present note. The twin seedlings shown in Fig. 1 were transferred without being separated, to a 12-inch earthen pot containing good garden soil mixed with farmyard manure. The vigorous and weak plants were separately labelled and all through their life the difference in vigour was found maintained. Even the inflorescence of the less vigorous plant was smaller though the seeds of both were of the same size. Selfed seeds

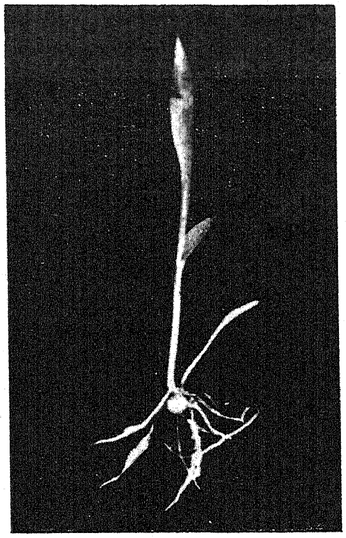

FIG. 1

of the two were collected separately. The following table gives the results of the progeny test in respect of the twinning habits:—

Character of plant	Total No. of seeds	Seeds germinated	Seeds that died	Single seedlings	Twin seedlings
Vigorous	532	495	37	495	0
Weak	131	69	62	69	0

Although the twins showed considerable difference in their size and vigour, they were presumably diploids, since both gave rise to normal progenies.

Reference to literature has shown that the occurrence of any type of twinning in *Sorghum* has not been reported previously. That only three such cases were observed in thousands of seeds shows that it is of very rare occurrence.

L. S. S. KUMAR.

College of Agriculture,
Poona,
May 27, 1942.

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1 Frost, H. B., *Hilgardia*, 1926, **1**, 365 (cited by Webber[4]).
2 Ramiah, K., et al., *Ind. J. Agr. Sci.*, 1935, **5**, 119.
3 Webber, J. M., *J. Agr. Res.*, 1938, **57**, 155.
4 —, *Bot. Rev.*, 1940, **6**, No. **11**, 575.

FALSE POLYEMBRYONY IN VIVIPAROUS *RHIZOPHORA MUCRONATA* LAM.

Rhizophora mucronata Lam., is a mangrove plant which bears fruits with viviparous seeds. Before the fruit becomes detached from the parent tree, the single seed inside germinates and by growth of the cotyledons and later enlargement of the hypocatyl, which pushes out through the micropyle, the lower part of the embryo is formed into a club-shaped structure 10″ to 20″ long. When the fruit drops down into the swamp surrounding the plant, the root-end penetrates the mud and gets established by development of the main and lateral roots. If the fruit drops down during high tide, when the swamp is usually flooded, the seedling may be carried away by the tide and gets established later.

In *Rhizophora mucronata*, the most common occurrence is that of fruits each bearing a single well developed hypocotyl indicating the presence of one normal embryo. The specimen illustrated on the right in the photograph (Fig. 1) was collected from the saline swamps of Bandra Creek near Bombay. The unusual feature of this specimen is the presence of twin hypocotyls emerging from a single fruit. As normally only one seed is formed in a fruit in *Rhizophora*, from an external examination of this specimen, it seemed that two embryos had developed from the same ovule. When the pericarp enveloping the plumular part was carefully dissected it was observed that each of the twin hypocotyls was connected with its own separate plumule and also enclosed by separate nucellar tissue, tegmen and other tissues of two distinct ovules which, however, were more or less adhering to each other. So this is a case of false poly-embryony of the type recently reported by Howard in *Brassica*. A large number of fruits were dissected out and only in another case we found the presence of a second ovule with its young embryo.

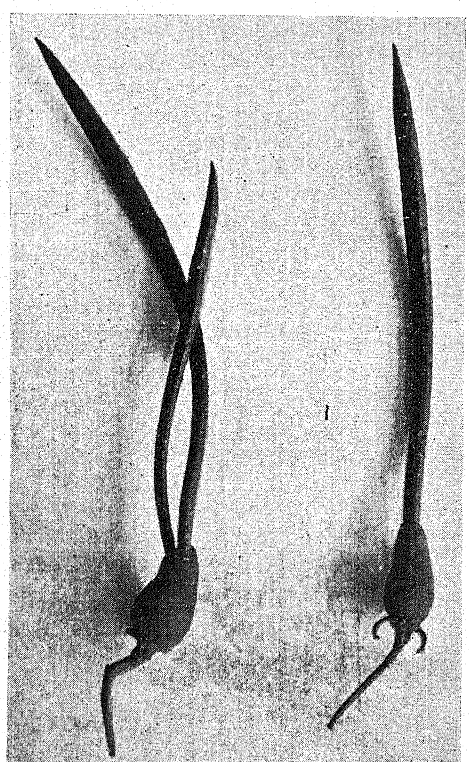

FIG. 1
Photographs of normal (on left) and abnormal fruits of *Rhizophora mucronata*.

L. S. S. KUMAR.
W. V. JOSHI.

College of Agriculture,
Poona,
May 26, 1942.

[1] Howard, H. W., *J. Genet.*, 1939, **38**, 325.

BALANOGLOSSUS AS FOOD OF FISHES*

SRI. S. VARADARAJAN recorded for the first time on 6th July 1940 and 1st August 1940 that the Whiting *Sillago sihama* and the Squeaking Perch *Therapon jarbua* had a specimen of Balanoglossus in their stomach contents. This led to the present investigation.†

A systematic collection of fishes from both the 'Balanoglossus area' and the Watchman's Bay was arranged. The fishes were caught by

* Published with the permission of the Joint Director of Industries and Commerce, Madras.

† As Sri. S. Varadarajan, M.A., was transferred to West Hill Biological Station, Malabar, on 11-9-1940 he could not pursue this item of research.

stake-nets 1½′ high, planted within the shore during the low tide, especially during the New Moon and Full Moon days. During the high tide, water with its finny inhabitants flows above and over the net; but when the tide recedes most of the fishes are trapped in the net. The following four species of fish are generally represented in the catches made by this method:—(1) the Whiting, *Sillago sihama,* (2) the Mullett, *Mugil waigiensis,* (3) the Mullett, *Mugil troschelii,* and (4) the Squeaking Perch, *Therapon jarbua.*

The stomach-contents of the above fishes were studied in detail; and the following observations were recorded:—

(1) *Sillago sihama* (125 specimens).—Polychæte worms, crabs, prawns, stomotopods, 14 specimens of *Zonogobius* sp.,‡ Balanoglossus, amphipods, sea-weeds and sand-grains.

(2) *Mugil* spp. (200 specimens).—Moults of polychæte worms, copepods, amphipods, Thalassiothrix, Bacteriastrum, Rhizosolenia, Trichodesmium, Nitzschia, Pleurosigma, Fragilaria, Algal filaments and sand-grains.

(3) *Therapon jarbua* (25 specimens).—Polychæte worms, crabs, 14 specimens of *Zonogobius* sp., prawns, stomatopods, amphipods, Balanoglossus, sepia, fish-scales and sea-weeds.

Of the 125 specimens of *Sillago sihama,* 12 specimens showed Balanoglossus in their stomach, that is, nearly 10 per cent. feed on this worm; similarly, of the 25 specimens of *Therapon jarbua* examined, 3 specimens had Balanoglossus in their stomach, that is, 12 per cent. favour this diet. Balanoglossus is therefore not a general item of food of these fishes. In spite of these enemies, no reduction in the population of Balanoglossus has been noticed. Thanks to the comparative freedom the bed of Balanoglossus—being in the tidal zone—enjoys, sea-water can cover it only during the high-tides, twice during 24 hours. The two fishes in question are, therefore, deprived of access to the bed at low tides; their ravages can only be intermittent and in a pell-mell fashion as they have to retire with the ebbing tide. It is also likely that the fecundity of these worms copes with the destruction caused by these fishes and that the balance of nature is in favour of the Balanoglossid worms.

From the detailed study of the stomach-contents, it is seen that Balanoglossus is not an item of food of the mullets though they are caught in the area along with the Whiting and the Squeaking Perch. The snout of the specimens which had fed on Balaniglossids smells of iodoform. Balanoglossids swallow sand, and their intestine is almost always filled with sand. The above fishes when they feed on Balanoglossids, naturally swallow sand-grains also. Further, to get Balanoglossids and polychæte worms, the fishes probably have to dig into the sand with their snout.

During the investigation, we were confronted by the following problems:—What originates the iodoform smell? If Balanoglossus is responsible for it, can it be a protective device as iodoform has a disagreeable smell or is it a disinfectant employed by Balanoglossus for coating its burrows with, or can it be a product of the gut of Balanoglossus which, like the earthworm, swallows earth (sand) and throws it out as fæces? The substratum in the Balonoglossus area is subject to the gut-action of these worms all over there.

D. W. Devanesen.
P. I. Chacko.

Krusadai Biological Station,
Gulf of Manaar,
March 19, 1942.

‡ It was not possible to determine the species as the specimens had been partly digested,

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FOOD AND FEEDING HABITS OF THE OIL SARDINE AND MACKEREL

Devanesen in an article in this *Journal*[1] has made some valuable observations regarding the food of certain commercially important fishes of the west coast.

A study of the food and feeding habits of

the shoal fishes of the Trivandrum coast in relation to the plankton distribution has been carried on by one of us (M. A. S. M.) since July 1938[2] and our observations in regard to certain points dealt with by Devanesen are at variance with his.

About the food of the oil sardine (*Sardinella longiceps*) and the mackerel (*Rastrelliger kanagurta*), Devanesen observes, "Recent researches have revealed that both the oil sardine and the mackerel regularly and normally feed on fish eggs occurring in the plankton". On the Trivandrum coast mackerels appear in large shoals during September to November and March to May, and oil sardines during September to November. The analyses of several samples[3] of the gut contents of these two fishes during the course of our investigation show that they are essentially phytoplankton feeders, the chief and common items in their dietary being diatoms like *Coscinodiscus, Rhizosolenia, Thalassiothrix* and *Pleurosigma*; and dinoflagellates like *Peridinium, Ornithocircus, Dinophysis, Peridiniopsis* and *Ceratium*. Radiolarians, larval bivalves, *Evadne*, copepods (mainly *Temora*) and their nauplii also form common items of their food. The mackerels of this coast are often found to feed on macroplankton organisms such as Leucifers, Mysids, *Acetes* and other crustaceans, besides polychætes and fish fry. These are not, however, regular constituents of the food of the oil sardine. Fish eggs have never been noted in the gut contents of these fishes whereas Devanesen has recorded them as a regular item in the dietary of the mackerels and oil sardines of the Calicut coast.

He has also stated that the blue green alga, *Trichodesmium* found in the plankton off Krusadai in great abundance during certain seasons forms a favourite item of food of the Indian Sprat *Sardinella gibbosa*. On the Trivandrum coast large patches of *Trichodesmium* appear in the inshore waters at intervals during December to April, and its occurrence is found to have an inhibiting influence not only on the plankton feeding fishes, but also on certain other plankton organisms themselves. None of the plankton feeding fishes of this coast is found to graze on these patches of *Trichodesmium*, though on a single occasion, on 18th April 1940, three specimens of *Clupea atricauda* examined had plenty of these alga in their gut contents. But judging from the normal feeding habits of this fish observed during the course of our investigation, this is to be taken merely as exceptional. Such instances of indiscriminate feeding have occasionally been noted in other fishes also.

It may also be noted in this connection that the quantities of oil sardines and mackerels landed annually in the fishing villages to the north of Quilon in central Travancore, are considerably greater than the catches obtained to the south of Quilon. This difference in the distribution of the shoals is, then, to be correlated with the difference in their feeding habits. But recent food analyses conducted by Mr. K. Gopinath[4] of this Laboratory on the gut contents of oil sardines obtained from various fishing villages to the north of Quilon in Travancore, have confirmed our observations. Considering the fact that the seasonal distribution of the plankton of the Trivandrum and Calicut coasts is almost identical, the dissimilarity in the feeding habits of the same species of fishes common to both the regions, should be attributed to some unknown factor which requires further investigation.

C. C. JOHN.
M. A. S. MENON.

Marine Biological Laboratory,
University of Travancore,
Trivandrum,
May 1, 1942.

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[1] *Curr. Sci.*, 1942, **11**, 142.

[2] A detailed report on this work is under preparation and will be published elsewhere.

[3] Stomach contents of 222 specimens of oil sardine and 572 specimens of mackerel were examined.

[4] Our thanks are due to Mr. K. Gopinath, Assistant Research Officer, for supplying us with the information.

ON THE OCCURRENCE OF CARIDINA (ATYIDAE, DECAPODA) IN TRAVANCORE

WHILE engaged on a Faunistic survey of the Decapod crustacea of Travancore, chiefly the prawns of the Penæid and Palæmonaid group, a few species of *Caridina* were obtained from certain localities of this State. Probably this is the first record of the occurrence of this genus in Travancore. The collection consists of the following four species:—

1. *Caridina gracilirostris* de Man.[1]

C. gracilirostris occurs in large numbers among the aquatic vegetation on the border of the Veli lake. Large females collected in July (1939) were found to carry numerous eggs in their brood pouch. The largest ovigerous female in the collection is 35 mm. and the largest male 30 mm. in length.

2. *C. lævis* Heller.[2]

Two collections of this species were made, one in September and another in November 1939, from among the aquatic vegetation in the submerged paddy fields of Kuttanad in central Travancore. The collection includes a number of ovigerous females measuring from 14 to 20 mm. in length. The number of eggs in the different individuals varies from 40 to 60. The eggs of this species are distinctly larger than those of the other species recorded from Travancore and measure about 0·7 to 1·0 mm. along the long axis and from 0·4 to 0·5 mm. along the short axis. Live specimens are light brown in colour.

3. *C. nilotica* (Roux) var. *gracilipes* de Man.[3]

Three males, two ovigerous females and three young ones of this variety were collected from Kuttanad in central Travancore. One point of difference, however, to be noted between the present collection and the named examples in the Indian Museum is, that the former are slightly larger, the ovigerous females measuring about 24 mm. and the largest male 21·6 mm. in length. Compared to *C. lævis* this variety appears to be rather rare in Kuttanad. Live specimens are dark brown in colour.

4. *C. weberi* de Man.[4] var.

The Water Analyst of the Wellingdon Water Works, Trivandrum, placed at my disposal a few specimens of this species, which he collected from the water supply mains, in March 1940. The largest male is 13·5 mm. and the largest female 15·5 mm. in length. The collection does not include any ovigerous female.

These specimens are closely allied to the variety '*sumatrensis*'* inasmuch as they possess a number of dorsal teeth on the carapace behind the orbit, and that the palmer portion of the second peræopod is more than half the length of the dactylus.

One noteworthy fact which emerges from the study of the local distribution of these species is that while *C. gracilirostris* is very common in the Veli lake, a small brackish water lake situated three miles north of Trivandrum, it is not found in central Travancore. Similarly, *C. lævis* and *C. nilotica* var. *gracilipes*, the common species of central Travancore, are not found in the Veli lake. This may be due to the fact that the species found in the Veli lake is a brackish water form, while the species found in central Travancore are exclusively fresh water in their distribution. The Veli lake is in direct communication with the sea during certain months of the year and is subject to varying conditions of salinity. But the localities from where *C. lævis* and *C. nilotica* var. *gracilipes* were collected, are purely fresh water areas beyond tidal influence. This difference may probably account for the conspicuous absence of *C. gracilirostris* in central Travancore.

S. NATARAJAN.

Marine Biological Laboratory,
University of Travancore,
Trivandrum,
May 15, 1942.

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[1], [2] de Man, *Max Weber's Zoolog.*, 1892, pp. 365-399, text and plates.

[3] —, *Rec. Ind. Mus.*, 1908, **2**, p. 270. pl. **20**, figs. **7**, 7 *a* and 7 *b*.

[4] Kemp, S., *Ibid.*, 1913, **8**, pp. 305 and **306**, pl. **29**, figs. 24 and 25, pl. 20, figs. 26 and 28.

* "The variety '*sumatrensis*' was recorded from Sumatra (de Man, 1892) from Engano Island near Sumatra (Nobili, 1900) and from Cochin, China, Siam and environs of Bombay (Bouvier, 1905)."

My thanks are due to the Water Analyst, Mr. P. G. Nilacanta Pillai, B.A., M.Sc., for the collection of *C. weberi*.

ERGOT IN INDIA

I WAS interested to read the note "Ergot in India" published in the November 1941 issue of *Current Science*. It may be noted that the first collection of the Ergot (*Sphacelia sorghi*) on Jowar (*Sorghum vulgare* Pers.) was made at Dharwar by the undersigned in 1915. Later on it was also found on *Andropogon annulatus* Forsk., *Andropogon caricorus* L., *Ischœmum pilosum* Tri., and *Pennisetum alopecuros* Steund.

In the Bombay Karnatak the fungus is quite common on the Jowar crop causing considerable damage particularly in the years when the crop is late sown.

On *pennisetum alopecuros* the dark, sticky, bent selerotia are quite conspicuous.

These have been recorded in the publication *The Fungi of Bombay*[1] and the original samples collected by the writer may be found in the herbarium of the Plant Pathologist, Agricultural College, Poona.

G. S. KULKARNI.

Central Farm,
Gwalior,
May 11, 1942.

[1] Bulletin No. 176 of 1934, Department of Agriculture, Bombay, Poona.

ALTHOUGH it was apparently collected before that date by the above writer, the fungus *Sphacelia sorghi* was first described by McRae in 1917. It is quite different from the fungus found in the Simla hills, having spores $7 \cdot 6\text{-}16 \times 4\text{-}6\,\mu$, as compared with $3 \cdot 6\text{-}11 \cdot 0 \times 1 \cdot 8\text{-}4 \cdot 6\,\mu$ for the largest collection of spores on the Simla specimens.

G. WATTS PADWICK.

Imperial Agricultural
Research Institute,
New Delhi,
May 30, 1942.

THE FATTY OILS FROM THE SEEDS OF *MOMORDICA CHARANTIA* AND *MOMORDICA DIOICA* (N. O. CUCURBITACEÆ)

THE seeds of *Momordica charantia* and *Momordica dioica* were obtained from villages in the immediate neighbourhood of Kolhapur. The oils from these seeds were obtained in each case by treating the decorticated seeds with carbon tetrachloride in a soxhlet apparatus. The yields have been calculated on the weight of the decorticated seeds. The physical and chemical constants of these oils have been determined and the data obtained are summarized in the Table below.

	Momordica charantia	*Momordica dioica*
Yield of the Oil ..	35%	40%
Specific Gravity at 25° C.	0·9962	0·9892
Refractive Index at 25° C.	1·4985	1·5170
Acid Number ..	4·75	2·78
Saponification Value	181·3	186·6
Iodine Value ..	73·33	72·66
Reichert-Meissel Value ..	2·52	3·05
Polenske Number ..	0·62	1·81
Acetyl Value ..	2·0	7·72
Unsaponifiable Matter ..	0·6%	0·7%

The oils are green in colour and become rancid on exposure to the air. They have the smell peculiar to the fruits themselves. In carbon tetrachloride solution the oils appear red. The details as well as the subsequent work done will be published elsewhere.

J. W. AIRAN.
S. V. SHAH.

Rajaram College,
Kolhapur,
March 8, 1942.

REVIEWS

The Mechanism of the Human Voice. By Robert Curry. (J. & A. Churchill, Ltd., London), 1940. Pp. viii + 203. Price 10*sh.* 6*d.*

In common with other branches of acoustics, the scientific study of the human voice has acquired a new interest as the result of recent developments in the recording, reproducing, transmission and broadcasting of human speech. Recent advances in science have also given us more efficient methods for observing the movements of the vocal organs in action and for analysing the character of the sounds of speech and song. It is possible, for instance, to observe the movement of the vocal chords in any desired phase of vibration using periodic illumination of which the frequency is controlled by the voice itself. Modern X-ray tubes enable very clear photographs of the larynx and the vocal chords in action to be obtained. Modern microphones and cathode ray oscillographs enable us to make oscillograms of speech and song more satisfactory than those possible with mechanically operated phonodeiks. Methods have also been developed by which the harmonic components of a musical sound may be instantaneously exhibited in the form of a line spectrum. The use of such new techniques has brought on a great accession of fresh knowledge.

As remarked by Dr. Guthrie in his Foreword to the book under review, voice and speech are of supreme importance to mankind. It follows that a treatise in which available knowledge regarding the mechanism of the human voice is examined and summarised must be of interest and value to many readers. Amongst those who are professionally interested in some aspect or other of the subject may be mentioned physicists, physiologists, medical specialists, phoneticians, teachers, public speakers, singers, telephone and radio engineers. Even the lay reader may feel interested in such questions as the following:—What is it that distinguishes the voices of different individuals from each other? What is the cause of the difference between male and female and between child and adult voices? What are the causes of stuttering and stammering? Is it possible to improve one's voice for speaking or singing by systematic training? What are the voice characters of an exceptionally fine singer? Why do some languages sound differently from others? Can the human voice be artificially imitated? The reader of Dr. Curry's book will find such questions discussed in it.

A perusal of the book shows that it is the product of both extensive and intensive study of the subject in its varied aspects. It covers a wide range of topics in a relatively small compass without being superficial or obscure. The numerous references given in the text and listed at the end will enable the reader who desires further knowledge on special topics to turn to the original literature. The book is well-produced and moderately priced. It may be heartily recommended.

C. V. RAMAN.

The Analytical Chemistry of Industrial Poisons, Hazards and Solvents. By Morris B. Jacobs, PH.D. (Inter-Science Publishers, Inc., New York), 1941. Pp. xviii + 661, 110 illustrations. Price $7.

This is the first of a series of monographs on analytical chemistry and its applications to be published by Inter-Science Publishers, Inc., and all concerned are to be congratulated on a notable addition to chemical literature.

The book is divided into nineteen sections with suitable sub-classifications, an appendix of valuable tables, and author and subject indexes.

Before proceeding to describe the chemistry, properties and determination of a comprehensive list of individual elements and compounds, five preliminary chapters are devoted to an illuminating discussion of industrial hygiene and industrial poisons. These comprise a descriptive chapter on drawing representative samples, the measurement of gas volumes and quantities, the apparatus and chemicals used for absorption and adsorption and their relative efficiencies and a description of the various methods of estimating dust microscopically and by chemical methods. The information in these general chapters is supplemented wherever necessary by more specific instructions throughout the text.

Wherever calculations or physical instruments of any other than stereotyped classes are described, the mathematics is adequately discussed and the apparatus illustrated by clear annotated diagrams.

In the following chapters are detailed the properties and general features of a very complete range of elements and compounds important in industrial hygiene and toxicology or used in chemical warfare. Methods of detection and determination adequately dealt with in the text are followed in all cases by valuable information on "physiological response", a notable and welcome feature of the work.

This volume is far too detailed to be classed as a text-book. It is a work of reference which should find a place in the equipment of the chemsits and works managers of all factories carrying out hazardous industrial occupations and in the libraries of universities, medical men and those working in the field of public and factory hygiene.

The paper, printing and diagrams are excellent and the bibliography is comprehensive and up to date. Printer's errors are few and far between but a rather more comprehensive subject index would have been an improvement as the present one does not contain many of the trade names or symbols of important compounds or preparations mentioned in the text. In cases of multiple references, it would also be an advantage if the page on which the principal and most detailed information is to be found were printed, as is common practice, in bolder type.

This minor criticism can easily be dealt with in a reprint or new edition which should soon be necessary to meet a demand stimulated by merit at a time when scientific method and control are being increasingly standardised in industry and social services.

H. B. Dunnicliff.

Experimental Physical Chemistry. By W. G. Palmer, D.Sc. (The University Press, Cambridge), 1941. Pp. xi + 321. Price 12*sh.* 6*d.*

This book by Dr. Palmer is obviously the outcome of a considerable amount of practical experience and demonstrates how many of the important principles of physical chemistry can be approached through the laboratory with the help of quite ordinary equipment. There is always a fascination in these home-made apparatus, particularly when they combine simplicity with reasonable accuracy. The book covers most of the syllabus for an Honours degree, and some of the exercises are indeed appropriate for more advanced students. Experiments which require special equipment such as Bomb Calorimeter, Refractometer and Spctroscope, are left over for reference to larger books. The chapters on Ionisation and Dilution will be found to be extremely useful to students and teachers in Universities and Colleges. A new and interesting feature is a chapter of exercises on crystallisation and properties of crystals. Lucid theoretical notes introduce each chapter and completely worked examples based upon data obtained with the apparatus as actually described elucidate in a most direct way the difficulties, demonstrate the possible accuracies, and assist in an orderly and significant exposition of data.

This book is to be highly commended to all Universities and Colleges.

M. A. G. Rau.

Analytical Processes—A Physico-Chemical Interpretation. By T. B. Smith. (Edward Arnold Co., London), 1940. Pp. viii + 470. Price 18*s.*

To incorporate, in the second edition of this useful book, the recent developments in the theory and the practical aspects of the subject, the author has effected considerable revision of the text. Matter adequately dealt with in standard text-books on physical chemistry has now been omitted and this has rendered it possible, with only a moderate increase in size, to have a discussion at length, of certain important aspects of analytical chemistry.

Notable topics considered in the book are: activity coefficients, modern conception of acids and bases, pH changes during acid-alkali titrations, hydrolysis, adsorption, adsorption indicators, oxidation and reduction processes. The chapters dealing with typical precipitations such as the sulphates of barium and lead, ferric hydroxide, the insoluble halides of silver, the separation of calcium from magnesium, are full of interest.

The book lays due emphasis on the theoretical principles of quantitative analysis. Without an adequate background of mathematics, however, the honours student in

chemistry will find it difficult to understand the mathematical treatment of physical chemistry in certain parts of the book.

The book is to be highly recommended as a reference work for honours students and as a supplement to ordinary text-books for those taking an advanced course in analytical chemistry. B. S. RAO.

Report on the Zoological Survey of India for the years 1938-41. (Manager of Government of India Publications, Delhi), 1942. Pp. 83. Price Rs. 2-6-0 or 4*sh.*

In the latest Report of the Zoological Survey of India, the Director has reviewed the various activities of the Survey—both in the field and in the laboratory—during the period 1938-41. The studies connected with the influence of the injurious organisms on the efficient working of the beds at Pulta Water Works, were continued during the period. The working of the Pulta beds has already materially improved after giving effect to the suggestions made by the Survey. Important investigations have been carried out on the migration of *Hilsa* fish. Several students from different parts of India were given facilities to conduct investigations and to learn the modern technique in zoological research. That most of these students have worked on fish and fisheries is a sign of the growing interest in ichthyology in India.

Among the outstanding contributions of the Department for the period are, Dr. Hora's work on the habits, life-history, etc., of *Hilsa,* the series of papers in which Dr. Hora has discussed the geographical relations of the Satpura Trend of mountains; Dr. Prasad's work on Pelecepods of India; Dr. Chopra's work on Crabs and Prawns from Karachi and other areas; Dr. Rao's work on Andaman Shell Fisheries and his consolidated report on it and Dr. Hafiz's papers on Hemiptera. During the period under report, large collections of both invertebrate and vertebrate animals have been added to the reserve material of the Department. Several papers have been published on this material by the leading specialists. The Departmental publications, namely, *Records* and *Memoirs of the Indian Museum,* have continued to maintain a high reputation as the leading journals for the publication of zoological work in India.

The funds sanctioned by the Government of India for the maintenance of the Zoological Galleries of the Indian Museum are very insufficient. If the valuable material collected by the Department has to be exhibited properly for the benefit of the public, the Government ought to provide adequate funds for the purchase of properly designed show-cases and for other expenditure connected with the preparation and display of specimens.

It must be emphatically pointed out that the existing staff of the Zoological Survey of India and the funds provided for its working, both in the field of survey and research over a vast continent like India and the management of the Zoological Gallaries of the Museum, is very inadequate. The Director has rightly pointed out that the staff and the annual grants have to be materially increased if the Department has to work efficiently. B. S. B.

Report of the Education Department, London, 1939-40. (Office of the High Commissioner for India), 1941. Pp. 32. Price 3*s.* 8*d.*

This is a Report of thirty-two foolscap pages and it costs Rs. 2-12-0—perhaps the costliest Report ever published. It is commonly supposed that Government Reports are priced low in order that more people may buy them; but in this case it would appear that the opposite principle applies, namely, that more people should *not* buy them. Moreover, the title of the Report is most misleading. That the Report has any reference to India can only be discovered from the information, given inconspicuously in small type on the front page, stating that it emanated from the Office of the High Commissioner for India.

The Report deals with the arrangements that had been made, during the year 1939-40, for the education of Indian students in the various British centres of learning. The war had already caused considerable dislocation in these arrangements, but in spite of it all more than a thousand Indian students of both sexes had managed to carry on their studies, sometimes with great distinction. It is pleasing also to note that in these difficult circumstances Indian students not only showed commendable calmness and courage but many actually rendered valuable services in the prosecution of the war.

D. S. GORDON.

IRRIGATION RESEARCH IN INDIA

THE *Annual Report of the Central Board of Irrigation in India* (Publication No. 24, 1942, pp. ii + 260), is a record of the technical work of the Central Board of Irrigation during the year 1939-40. The technical discussions embodied in the Report are the result of two meetings of the Research Committee and the Eleventh Annual Meeting of the Central Board of Irrigation held during 1940. The contents of the volume are divided into twenty-one groups to facilitate reference and the discussions at the meetings appear classified under the different groups.

The Central Irrigation and Hydrodynamic Research Station, Poona, carried out during the year 1939-40, among other things, a number of experiments on silt control and scour in canals, river training, profile for high coefficient weir, canal falls of various designs, flow in expansions in open channels and scale effect of models. Theory, design and construction of Gibb modules, Ganges flood and its lessons and relationship between meander belts and width and discharge of rivers on flood plains and of incised rivers are some of the papers published by the Station.

The Punjab Irrigation Research Institute continued to carry out its investigations on river models of the Sutlej River downstream of Panjnad Headworks, the Chenab River upstream of Khanki Headworks, the River Ravi upstream of Madhopur Headworks, the Beas River upstream of Islam Headworks. The Chemical Section continued its work on the effect of the soil crust on the rise of water-table and its studies on the stabilisation of soil. The transmission constants of water-bearing sands, the influence of shrouding, the diameter of the strainer and the influence of its position with respect to impermeable strata on the discharge and the determination of permissible velocity of flow through sand continued to engage the attention of the Physics Section. In the Land Reclamation Section, studies of the movement of moisture and salts in the soil were continued, both in the field and in the laboratory.

The Poona Irrigation and Research division was engaged during the year on problems connected with economy of water, land drainage and reclamation, and the adoption of effluent irrigation. The Development and Research Division, Sind, carried out a number of experiments on models of irrigation works, conducted a variety of experiments on the field, to determine the value of coefficient 'C' in the broad-crested weir formula, absorption and evaporation losses in water courses passing through typical soils in Sind, and requirements of water for various irrigation units, and conducted silt survey of channels and made investigations in connection with Lacey's silt theory and the statistical relation between the mean velocity of a section and the central surface velocity and such other relations. The United Provinces' P.W.D. (Irrigation) Research Section studied the efficiency of linings and the technique of sodium carbonate lining, conducted a number of experiments on models of irrigation works and carried out investigations on canal and gul losses.

Discussions at the meetings are, as already stated, classified into different groups. Among the subjects discussed are the following: Design of Channels in alluvium, Silting of Reservoirs, Flow in Rivers and Canals, Opinions on Kutter's and Manning's formulæ and Lacey's regime formula, statistical data pertaining to River Flood Control and Meandering of Rivers. Enumeration of some of the subjects discussed has been done to indicate the very valuable work carried out by the five Irrigation Research Stations in India. The Annual Report (Technical) of the Central Board of Irrigation is a volume containing much useful and instructive information on a variety of subjects of special interest to irrigation engineers.

C. GOPALAKRISHNAN.

PILOT PLANTS AS A BASIS FOR THE DESIGN OF LARGE-SCALE EQUIPMENT*

BY

M. A. GOVINDA RAU, M.A., PH.D.

(*Indian Institute of Science, Bangalore*)

WHETHER it is a new chemical process, or a fresh venture into the production of an already established product, the design of a full-scale plant for a given output must be based on trial experiments on a semi-works scale. But a correlation between the pilot plant and the full-scale works is not a simple exercise in arithmetic; it involves a careful and rational interpretation of the various attendant physical and chemical factors. Failure to recognise this has led to frequent disappointments, and financial failures on account of the unexpectedly poor performances of large-scale plants after erection. On the other hand, there are cases where very favourable results have been obtained with a large-scale plant, although the pilot-scale experiments were discouraging and difficult. A classical example of this is provided in the initial experiments of C. M. Hall on the manufacture of Aluminium. It is rather poignant that such an element of risk should be incident just where the biggest outlay in capital is involved.

A systematic study of the vast experiences gained in this field and a thorough understanding of the fundamental principles involved have led to the modern science of chemical engineering design. It is now possible with the help of these theoretical methods and a set of basic experimental data to design various types of industrial equipment of any desired capacity and performance, as for example, evaporators, fractionating columns, settling tanks, heat exchangers, absorption towers, driers, etc. All these achievements are, however, mostly confined to processes which involve in the main physical operations only. They also largely run parallel with corresponding developments in other branches of engineering. In all cases, the required 'model' experiments for acquiring basic data for design are planned on the principle of similarity. According to this principle, one determines a single or more dimensionless parameters which are characteristic for the operation under consideration. The functional relationships involving these dimensionless numbers are then determined through the model-scale experiments. Now, whatever be the size of the plant, for conditions which result in the same value for the dimensionless parameters, the function of the plant is identical, and can be correlated in a linear scale ratio. Thus, for all cases of fluid flow, correlative results are obtained at equal Reynold's numbers $\frac{DU\rho}{\mu}$, where D is a linear dimension which determines the flow such as diameter for a pipe with circular cross-section, U is the linear rate of flow, ρ the density and μ the viscosity of the fluid. Wide use is made of this principle, for example, in aerodynamic studies on model planes suspended in wind tunnels. Here with the help of the scale models and highly compressed air the value of $D\rho$ in the Reynold's expression is kept constant and the results obtained with the models then translated for the full-scale prototypes at the prevailing atmospheric pressures. Similarly hydrodynamic experiments are performed with ship models in water tanks in order to obtain the necessary data for the final shipping designs. Such conditions of dynamic similarity are also successfully employed for the design of heat transfer equipment in chemical plants. Here the dimensionless expressions required have to include additional temperature factors, and a few of those commonly used in design practice are:

the Prandtl number $\frac{C\mu}{K}$ for evaluating temperature drop across films,

the Peclet number $\frac{DU\rho C}{K}$ for heat transfer in viscous oils in laminar flow, and

the Grashof number $\frac{D^3\rho^2 g\beta\Delta t}{\mu^2}$ for heat transfer under conditions of natural convection.

Here C is specific heat, K the thermal conductivity of fluid, β the volumetric

* Contributed to a Symposium on "Fabrication of Scientific and Industrial Equipment," held at Bangalore, April 1942.

coefficient of thermal expansion, and the other symbols have the usual significance.

When a unit operation includes a chemical reaction also additional factors such as energy of activation, reaction velocity, etc. must be taken into consideration for deriving the appropriate dimensionless numbers for pilot plant studies. The problem thus becomes more complex but all the same it will be useful to determine one or more such criterions for similarity so as to enable one to predict with reasonable certainty the effect of a change of scale.

Few systems are governed by a criterion of purely chemical similarity with respect to concentration, reaction rate, etc. Several physical factors are inevitably associated with the systems in which chemical reactions take place. Thus, materials must be transported to and from the reaction centres by diffusion or turbulent currents. Frequently considerable heats of reaction have to be suitably transferred to the surroundings from the interior in order that a system may be maintained at a desired reaction temperature. The conditions of dynamic similarity dictated by such physical factors are in general not compatible with corresponding conditions required for purely chemical similarity. For example fluid velocities required to give equal Reynold's number would not allow of equal reaction times in the large- and small-scale apparatus. A complete mathematical solution of this problem is beset with difficulties. However a solution can be approached by first considering systems under conditions in which one of the factors alone is predominant. Thus, for a process in which the chemical reaction velocity is sufficiently low to be determinative, factors of chemical 'resistance' are the most significant, and the "physical resistance" factors can be ignored. Hence for drawing up correlations, conditions of dynamic similarity will play a very much less prominent role compared to conditions of chemical similarity. On the other hand, if the physical resistance is much the greater of the two, then conditions for chemical similarity can be ignored and scale relations can be drawn for conditions of dynamic similarity only, as for example, the maintenance of the same degree of turbulent motion in both systems.

The first attempt on problems of this nature was made by Prof. Damkohler of Gottingen in 1936 (*Z. Elektrochem.*, 42, 846). Proceeding from fundamental equations expressing conservation of mass, heat, and momentum, he derived the following four characteristic dimensionless factors:

$$\text{I.}\quad \frac{\text{Number of molecules chemically changed}}{\text{Number of molecules supplied by turbulent currents}} = \frac{\nu_j U l}{C_j v}.$$

$$\text{II.}\quad \frac{\text{Number of molecules chemically changed}}{\text{Number of molecules supplied by diffusion}} = \frac{\nu_j U l^2}{C_j D_j}.$$

$$\text{III.}\quad \frac{\text{Chemical heat developed}}{\text{Heat removed by convection}} = \frac{QUl}{C_p \rho \theta v}.$$

$$\text{IV.}\quad \frac{\text{Chemical heat developed}}{\text{Heat removed by conduction}} = \frac{QUl^2}{\lambda\theta}.$$

Where ν_j is the stoichiometric coefficient of substance j, for the chemical equation

$$\nu_1 A_1 + \nu_2 A_2 + \cdots \rightarrow \nu_3 A_3 + \nu_4 A_4 + \cdots\cdots$$

U is the true chemical reaction velocity $\frac{\text{Moles}}{\text{Cm.}^3\ \text{Sec.}}$

l = linear dimension of system.

C_j = molar concentration of substance j.

D_j = Diffusion coefficient of j, $\frac{\text{Cm.}^2}{\text{Sec.}}$

Q = Heat of reaction per mole, $\frac{\text{Cal.}}{\text{Mol.}}$

C_p = Specific heat of reaction mixture at constant pressure.

ρ = density of reaction mixture.

v = flow velocity of reaction mixture.

θ = temperature above an arbitrary zero.

K = Thermal conductivity of reaction mixture.

If any of these numbers be identical in the two systems, large and small, then a chemical process must be proceeding identically in both but with different total performances. Damkohler has considered the simplified case of a cylindrical reaction vessel, and derived from the groups I, III and IV, relative dimensions for the small- and large-scale sizes with a ratio of output n. The chemical process assumed is a continuous one, with a turbulent flow through the system, the rate of chemical reaction being the controlling factor.

I. Homogeneous reaction—

	Small	Large
Length in direction of flow	L	$Ln^{\frac{2-m}{2+m}}$
Diameter	D	$Dn^{\frac{m}{2+m}}$
Fluid velocity	v	$vn^{\frac{2-m}{2+m}}$

II. Heterogeneous reaction—

Length in direction of flow	L	$Ln^{\frac{2}{2+2m}}$
Diameter	D	$Dn^{\frac{m}{2+2m}}$
Fluid velocity	v	$vn^{\frac{2}{2+2m}}$

It is found that $m \sim 0{\cdot}8$, for turbulent flow, and $m \sim 0$, for laminar flow. Thus when $n = 10$, that is for a tenfold increase in production, the cylindrical reaction vessel must be 3·3 times longer and its diameter only 1·7 times more. The reaction vessel is thus geometrically distorted.

R. Edgeworth-Johnstone has more recently taken the subject up a little further [*Trans. Inst. Chem. Eng.* (England), 1939, p. 129] by introducing simpler dimensionless factors derived from the rate of reaction formula and the Arrhenius equation relating to reaction velocity with temperature. For homogeneous chemical reactions of any order n, two dimensionless factors can be used

$(\chi_n \cdot a_2 \,..\, a_3 \,...\, a_n \cdot t)$ and E/RT,

where χ_n is the constant in the Arrhenius equation $K_n = \chi_n \cdot e^{E/RT}$, a_n is the stoichiometric concentration, and the other symbols have the usual significance. For heterogeneous chemical reactions, the extent of interfacial areas must also be taken into consideration. On the basis of the above similarity principles Edgeworth-Johnstone has shown that if two reaction vessels have volumes V and n^3.V, *i.e.*, are related by scale factor n, then for a chemical reaction taking place at the same temperature and with the same initial concentrations, the volume rates of flow should be Qn^3 for the homogeneous reaction, Qn^2 for a heterogeneous system filled with geometrically similar catalyst grains, but Qn^3 for a heterogeneous system filled with catalyst grains of identical size in both systems.

The theoretical considerations outlined above regarding the application of similarity theory in chemical plant design constitute an important development of considerable significance in Chemical Engineering. Their practical utility is at present somewhat limited, but to a large extent they serve to visualise and to understand the nature of the difficulties in the designing of large-scale equipments on the basis of pilot plant work.

CENTENARIES

Lukin, Lionel (1742–1834)

LIONEL LUKIN, British inventor of life-boats, was born at Dumow 18 May, 1742. He became a member of the Coachmakers' Company in 1767 and continued in that business till 1824. He was a personal favourite of George IV and of Windham, the Secretary of State for War. He was also full of fertile mechanical gifts.

The first life-boat was conceived by Lukin in 1785. His pamphlet on this invention was published in 1790. Despite the patronage of the king, public apathy in regard to shipwreck stood in the way of Lukin getting his due recognition during his life-time.

Lukin secured buoyancy by means of a projecting gunevale of cork and air-chambers inside. He secured stability by a false iron keel. Lukin also invented a raft for rescuing persons from under ice, a rain gauge and an adjustable reclining bed for patients.

Lukin died at Hythe, Kent, in his ninety-first year, 13 February, 1834.

Seaward, Samuel (1800–1842)

SAMUEL SEAWARD, a British Engineer, was, with his brother John, the joint-owner of the Canal Iron Works which specialised in marine engines. The brothers supplied machinery to all parts of the world. They were pioneers in the construction of engines which provided speed without loss of comfort. The double-slide valve both for the steam and the exhaust, which they invented, resulted in a great saving in the consumption of fuel. This led to the adoption of their engines by the vessels of the East India Company and of several navigation agencies. They also advocated the use of auxiliary steam power for the voyage to India.

Samuel Seward died in London 11 May, 1842.

Lofting, John (1659-1742)

JOHN LOFTING, a Dutch inventor, was born in 1659. He set up practice in London in 1688 as a merchant and manufacturer of fire-

engines. Before coming to London he spent seven years at Amsterdam with one of the masters of fire-engines. He applied his engines to some of the royal palaces, and private houses. But as he was not properly compensated, he was obliged to discontinue his efforts.

By the end of 1690 Lofting seems to have been engaged in the manufacture of fire-engines on a considerable scale. For in November of that year, he presented a petition to the king saying that "iron-ware being absolutely necessary for the making of your petitioner's engines for extinguishing of fire, and your petitioner being a Dutchman borne and ignorant of the laws of this nation, did import from Holland lately a small parcel of wire". This valued at £67-18-0 had been seized by the officers of the customs. This petition brought him the desired relief.

Lofting became bankrupt in 1700 and settled at Great Marlow. He died 16 June, 1742.

S. R. Ranganathan.

Madras University Library,
Coimbatore,
June 4, 1942.

SCIENCE NOTES AND NEWS

Depolarisation of Light Scattered by Sols.—Hoover, Putnam and Witenberg (*J. Phys. Chem.*, 1942, 46, 81) have reported careful measurements of the depolarisation factors of the light scattered by monodispersions of bentonite and ferric oxide. The reciprocity theorem of Krishnan is found to hold accurately. The measurements can be taken advantage of for a rapid estimation of particle size of bentonite. The depolarisation values are found to be independent of concentration, if the concentration of the colloid is less than 0·1 per cent. K. S. G. D.

Viscometry.—Mr. T. Tirunarayanachar has described, in the *Indian Journal of Physics*, 1941, 15, 418) a convenient and improved type of the logarithmic decrement method for comparing the viscosities of highly viscous liquids. The vibration curves of a suitably mounted oscillating sphere are recorded by a simple photographic device, and from the measurements on the records, the damping coefficients can be estimated and compared. The method is demonstrated to be convenient and quick.

Anthelmintic Action of Phenothiazine.—Lapage (*Ind. J. Vet. Sci. & Animal Husbandry*, 1941, 11) has described in detail his experiments to assess the value of phenothiazine for the destruction of nematodes in sheep, goat, horse and pigs and the effect of the drug on the hosts. Given at the rate of 0·1 gm. per lb. of body weight to lambs and ewes, there was considerable fall in the egg count and by a comparative study it was elicited that this drug is far superior to either copper sulphate alone or copper sulphate and nicotine combined both in its anthelmintic and weight-increasing effects. Similar effect was observed in a goat which received a dose of 0·15 gm. of phenothiazine per lb. of body weight and in a horse which was given 0·1 gm. of phenothiazine powder per lb. of body weight.

S. D. A.

***Babesia foliata* n. sp. from a Sheep.**—A new species of *Babesia* found in the erythrocytes of sheep in Mukteswar-Kumaun, U.P., India, and named *Babesia foliata* n. sp. on account of its flattened and leaf-like outline, has been described (Ray and Raghavachari, *Ind. J. Vet. Sci. & Animal Husbandry*, 1941, 11). This species differs from the other two met in India, *viz.*, *Babesia sergenti* encountered in the Imperial Veterinary Research Institute, Mukteswar (1932) and *Babesia motasi* in Mysore by Achar and Srikantiah (1934). Transmission experiments on sheep and goats showed that the disease was transmissible to sheep by intravenous injection of fresh infected blood but not to goats. The ticks involved are not mentioned in this article. S. D. A.

Utilisation of Virginia Tobacco Seed.—Unlike the local varieties of tobacco in India which are all "topped" after some 12 to 16 leaves have developed and in that way prevented from flowering and setting seed Virginia tobacco is allowed to grow, flower and set seed, the reason being that a thin mild leaf is desired in the latter while in the former heavy and somewhat coarse and rank leaves are desired and the sap is all therefore directed into the leaves without any of it having to be used for flowers and seeds. There is at present some 1,25,000 acres of Virginia tobacco grown in the Guntur and adjoining districts of Madras, all of which is allowed to seed. As the seed required for sowing purposes is exceedingly small the quantity of surplus seed that is available is very large, estimated, in fact, at 8,000 tons per annum. Can these seeds be turned to any profitable use? The answer is furnished in certain studies by Swami Rao and Narasimham (*Ind. Jour. Agr. Sc.*, 12, Part II). These Virginia tobacco seeds are found to contain from 35 to 37 per cent. of an edible oil which is also a semi-drying oil. It therefore compares with ordinary gingelly oil as an edible oil and with linseed oil as a drying oil, although its drying properties are only partial unlike linseed oil. As against this drawback it is found that tobacco seed oil is quite colourless and does not develop a yellow tint in course of time in the white paints with which it may be mixed in the way that linseed oil does; so that, in these two respects it may be considered superior. The oilcake contains about 5½ per cent. of nitrogen and is a valuable cattle feed and can also be used as a manure. Neither cake nor oil has any nicotine in it and feeding trials with the cake as compared with groundnut oil

cake showed that they were similar and one could be substituted for the other. We are also told that viands made with tobacco seed oil were found quite as good as those made with gingelly oil. The material is thus made out to be a valuable product. We would, however, suggest considerably more by way of feeding trials of both cake and oil before they are attempted to be popularised for these purposes. As regards the oil for use in paints and varnishes, the Government of Madras has sanctioned a grant for further investigation.

A. K. Y.

Manufacture of Pine Wool.—The large pine forests of the Himalayas provide plenty of dry pine leaves, which, as they are hard and pointed, are known as pine needles. By collecting them, digesting with 1 per cent. caustic and further processing, a soft fibrous and sufficiently resilient material, known as 'pine wool' can be made. This is a very good packing material for fruits both soft and hard, and can in addition be used for stuffing mattresses and other upholsters, when the slight smell of pine oil which persists helps to provide hygienic properties also. Dr. H. N. Batham has carried out an extended series of experiments on the manufacture of pine wool and its cost, and published his results as Bulletin No. 30 of Department of Industries and Commerce, United Provinces.

Algal Parasites and Plant Diseases.—Many species of *Cephaleuros* are found to cause great loss to economic plants in India. *Cephaleuros mycoidea* Karst. causes the red rust of tea in Assam and Chittagong and other tea-growing areas. The alga is epiphyllous, developing in small discoid patches. The red colour of the filaments is due to the hæmatochrom which masks the green colour of the chloroplast. The damage caused to the tea leaves is very insignificant, but the twigs of the host which are parasitised by the alga, show stunted growth and etiolation, and gradually dry up. Extensive defoliation of the twigs is also of common occurrence. Mango plants are also found some times parasitised by *Cephaleuros mycoidea,* the infection causing the defoliation of twigs and other malformations.

In Florida, U.S.A., *Cephaleuros virescens* Kunze. (*C. mycoidea*) severely infects the leaves and fruits of Gauva plant. The twig and bark infections are of little consequence. The fruit blemishes are often said to be accompanied by cracking of immature fruits (Ruehle, *Phytopathology,* 31, 95). Distant plantings of the trees and application of fungicides like sulphur and Bordeaux mixture are the only means of controlling the parasite. M. J. T.

Agricultural Products as Insecticides.—About 100 million dollars' worth of insecticides and fungicides are employed annually against insect pests and fungous diseases causing an annual loss of three billion dollars in the United States of America. Although the materials, now largely used for this purpose (compounds of arsenic, fluorine, lead, copper and sulphur), are of mineral origin, vegetable products are also being used, to an increasing extent. This is because, many organic compounds are more toxic to insects, but less so to man, than are arsenates, and other inorganic compounds (poisons). In addition to organic insecticides that exist naturally in plants such as nicotine, anabasine, the pyrethrins, rotetone, groundnut oil and other plant oils, products derived from coniferous trees, such as Pine-tar oil, are also valuable insecticides; and synthetic compounds derived from oils, alcohols, furfural and other promising plant products, are now coming into commercial use as insecticides. It is conjectured that in the future, insecticides will be mostly organic compounds, obtained from plants now regarded as worthless weeds, or synthesised from products of plant origin. The possibilities of constructive chemical research in this field are boundless, and should result in numerous products of great economic value. (Roark, *Industr. Eng. Chem.,* 1939, 31).

Paper from Grass.—Investigations carried out at the Forest Research Institute on the possibility of utilising *ulla* grass (*Themeda arundinacea*), until recently known under the name of *Anthisteria gigantes,* for the manufacture of wrapping and packing papers are described in Forest Bulletin No. 100.

This grass is available in the forests of the United Provinces in sufficient quantity and at economic prices to support a mill with a capacity of about 6,000 tons per annum.

Petty shopkeepers, as well as big merchant firms, are making increasing use of imitation kraft paper (the average annual imports of which during the year 1935-36 to 1939-40 were about 10,000 tons) in place of old newspapers and brown wrappings, as the consumer nowadays "regards the use of kraft papers as decidedly cleaner, more hygienic and more acceptable to his æsthetic sense", says the Bulletin.

Investigation has shown that wrapping and packing papers produced from *ulla* grass are superior in quality to old newspapers and brown wrappings, while they are estimated to be cheaper than imported imitation kraft papers.

The Bulletin further points out that the total capital requirements for the manufacture of 6,000 tons of wrapping papers per annum is estimated (at pre-war price levels) to be approximately Rs. 31,00,000, and the yield on a capital investment of Rs. 27,00,000 about 8 per cent.

Manufacture of Dried Fruits from N.W.F.P.—A Press Note, dated 30th May 1942, issued by the Supplies Department, Government of India, states that a scheme for the scientific processing of dried fruits on a large scale has been introduced by the N.W.F.P. Government.

The plant, which is expected to turn out 4,000 tons of dried fruits per year, will include several up-to-date forced draft tunnel dehydrators and sulphur houses and a processing and packing plant, besides accommodation and equipment for receiving, preparing and storing the fruits.

The North-West Frontier Province and, to a lesser extent, Baluchistan are the main sup-

pliers of dried fruits required by the Defence Services. In both cases, however, the supplies are largely derived from Afghanistan *via* tribal territory. Hitherto, the fruits have been mostly sun-dried under indigenous conditions, with the result that rejection on account of dirt and insect infection have been considerable. During recent months, some processing has been undertaken by the N.W.F.P. Government on an existing plant, but the output has been limited owing to insufficient capacity. The present scheme, it is expected, will soon ensure an adequate supply of dried fruits, hygienically processed and packed.

Baluchistan Sulphur.—According to a Press Note, dated 6th May 1942, issued by the Department of Supply, Government of India, "deposits of crude sulphur discovered in Baluchistan are now being worked out by Government.

"In view of the extreme difficulty now being experienced in obtaining sulphur from America and of the high prices charged, it is felt that consumers would be well advised to investigate the possibility of using crude Baluchistan sulphur.

"An organization for the sale and distribubution of the ore is being set up under the supervision of the Directorate-General of Supply,. Chemicals Directorate, New Delhi, to whom all enquiries and applications for the ore are to be made."

Every endeavour will be made to supply ore containing not less than 50 per cent. of sulphur. The impurities which occur with the sulphur are not of a harmful nature and consist mainly silicious materials and calcium sulphate. Free sulphuric acid occurs to the extent of about one per cent. Arsenic is present in traces, generally determined as less than five parts per million. The crude sulphur is free from selenium and bituminous matter.

It is considered that this sulphur can be utilized in sulphuric acid plants using the chamber process and also in sugar refineries provided certain modifications are carried out to existing burners. Difficulties may arise over the high proportion of impurities present, but such difficulties are likely to be of a comparatively minor character.

For certain purposes, it is recognised that refined sulphur is essential and the Department of Supply is pursuing the question of erecting a refinery as soon as possible, but some months must necessarily elapse before the completion of such a plant.

Jute Yarn Tests.—During the last three years, among other important investigations undertaken, the Technological Research Laboratories of the Indian Central Jute Committee have carried out tests on a large number of samples of yarn representing the various qualities produced in the Calcutta mill area. Technological Research Memoir No. 4, just issued by the Indian Central Jute Committee, embodies the results obtained and gives full data for hessian warp, hessian weft, sacking warp, sacking weft and other qualities. "The results show the range in quality met with in each type of yarn as produced by different mills and give useful individual and mean values for the various characters examined, including grist, tensile strength, extension at break, ballistic work of rupture, twist and regularity.

"The data are used as the basis of a provisional scheme, set forth in the Memoir, for classifying the various types of yarn according to quality. This classification is based on strength and regularity.

"Although other characters, such as colour and degree of speckiness, are of importance in deciding the purposes for which a yarn is suitable it is considered that the two characters used in the main classification should be regarded as of prime importance in the scientific grading of yarns. A routine method for determining degree of speckiness is in operation in the Laboratories."

Causes of Maternal Mortality in the City of Bombay.—Investigations into the causes of maternal mortality, initiated by the pioneer work of A. Lakshmanaswami Mudaliar in Madras (1933), are of the greatest importance in any attempt to cope with one of the most acute health problems in India. Dr. (Miss) Jhirad has analysed and reported on the maternal mortality in Bombay from July 1937 to June 1938 (*Health Bull.* 29. Manager of Publications, Delhi, 1941. Pp. iv + 98. Price Rs. 1-8-0 or 2*sh.* 3*d.*). Among 38,243 births, 525 fatal issues occurred, giving a total mortality rate of 13·5 per 1,000 births. Excluding associated diseases, 340 fatal cases or 66·1 per cent. were directly connected with child-bearing which reduces the mortality to 8·33 per thousand. Puerperal sepsis was responsible for 39·1 per cent., anæmia for 17 per cent. of mortality, eclampsia and puerperal hæmorrhage follow with 11 and 9 per cent. respectively. Seventy-seven per cent. of the fatal cases showed an "avoidable factor" (Dept. Committee on Maternal Mortality and Morbidity) in their history. Of the total deaths due to sepsis 43·6 per cent. occurred in deliveries by untrained women (*dais*). Seventy-one per cent. of deaths were registered among the poorest population, living in one-room tenaments in congested areas. The surprising fact that only 28·8 per cent. of the maternal deaths are to be found among home deliveries, which is in accord with the fact that 75·7 per cent. of all the births took place in institutions, is explained by the authoress's statement that a fairly large number of small maternity homes under general practitioners and midwives are not any better than third class hotels and need drastic reform in the matter of over-crowding, sanitation and methods of work. Equally as important as the facts and figures, presented in a lucid and convincing way, are Dr. Jhirad's recommendations for reducing the maternal mortality to the level of the West, *viz.*, 3·8 per 1,000 live-births in England and Wales (1936). The highly dangerous untrained *dai* has to be eliminated and replaced by midwives, trained on the lines of a Midwives' Act, which should be brought into force without delay. "Flying squads", who could bring help to the patient's home, would popularise home deliveries, necessary to avoid over-crowding of hospitals. The training of the medical

practitioner needs substantial improvement; regular post-graduate and refresher courses are necessary to keep up his standard. Further development of ante-natal centres with a sufficient number of beds is essential and the public has to be taught by social service organisations, health visitors and municipal midwives to make early and regular use of them; among the investigated cases only 21·2 per cent. had adequate ante-natal care. Finally the housing conditions, the prices of essential foodstuffs, especially those containing the highest amount of vitamins, and their relation to the wages should attract the serious attention of the authorities. The investigation under review contains a wealth of valuable material, which should be studied by everybody concerned with the welfare of the community. ROBERT HEILIG.

The Tuberculosis Association of India.—The most important events during the year 1941 (*Annual Report*, Tuberculosis Association of India, New Delhi, 1941, pp. vi + 121) were the opening of the Lady Linlithgow Tuberculosis Sanatorium in Kasauli and the development of the New Delhi Tuberculosis Clinic. The sanatorium in Kasauli contains at present 120 general ward beds and 10 special wards, whereas the construction of 40 cottages is planned; further it affords training facilities for medical men who intend to specialize in tuberculosis (nine months' course). Opened in May 1941 and endowed with all the requisite diagnostic and therapeutic equipment, 29 patients were treated there for more than one month upto the end of the year.

The clinic in New Delhi is intended to serve as a diagnostic centre. The number of new cases which attended the clinic was 1,694. The patients are returned to referring institutions and doctors with diagnosis and advice and they are treated at the clinic only at the express wishes of the doctors concerned. The total number of patients who were seen at this institution since November 1940 was 20,375. Seventy-six cases were admitted to the eight clinical beds, meant for observation, treatment and minor operations. The clinic employs health visitors who investigate the patient's home conditions and bring "contacts" for examination to the centre; out of 869 "contacts", 10 per cent. were found to be suffering from tuberculosis. A simple and cheap outfit for the burning of sputum was devised and deserves wide distribution.

Reports on the working of the Medical Commissioner and the affiliated institutions in Provinces and States complete the picture of the Tuberculosis Association's manyfold activities.

It is the good fortune of India that every attempt to improve the still sad conditions of tuberculous patients finds the enthusiastic and powerful support of Her Excellency the Vicereine, the Founder-President of the Association. Her deep understanding of the specific local difficulties are expressed in the following words, which the medical profession should take to heart: "It is necessary to emphasize that the greatest difficulty in the tuberculosis campaign in India is not, as generally supposed, lack of money, but the lack of a sufficient number of doctors properly trained in modern methods of diagnosis and treatment. It is a hopeless task to try to fight tuberculosis in India without having doctors who have specialized not only in diagnosis and treatment but also in the prevention of the disease and in the care and after-care of the tuberculosis patient." ROBERT HEILIG.

Imperial Veterinary Research Institute.—According to the Annual Report of the Institute, just published, arrangements are being made to produce in India veterinary drugs which were previously imported. A considerable number of these drugs can be synthesised or extracted from indigenous plants. To develop this industry, experimental cultivation of medicinal plants on the plains and in the hills and tests on animals may soon be undertaken.

A new vaccine against Ranikhet disease, which is generally the cause of setbacks in attempts at large-scale poultry farming in India, has been produced at the Institute. Tests have proved that the new vaccine is capable of giving good and safe results.

Research on warble fly pest is now nearing completion. Data are available on the respective incidence of parasites in cattle and goats and the ecological conditions which are favourable for its development.

A comprehensive investigation has been started on the influence of climatic factors on animal disease in India. Among other problems under investigation are contagious pleuro-pneumonia, contagious abortion, acute theileriasis which is fatal to calves, diseases of goats and the utilisation of the so-called famine fodders.

The role of vitamins in animal nutrition has been studied. Chief interest is centred round vitamin "A" and its precursor, carotene, insufficiency of which is known to produce serious nutritional disorders common in India.

Indian Statistical Institute.—The Annual General Meeting of the Indian Statistical Institute was held on the 29th April 1942 at 4-30 p.m. in the Statistical Laboratory, Presidency College, Calcutta, with Sir A. H. Ghuznavi in the chair. The activities of the Institute during the year 1941-42 were reviewed in the Annual Report presented at the meeting. Among the various enquiries undertaken by the Institute during the year, mention may be made of the following:—Area Census of Jute, Bengal Labour Family Budget Enquiry, Crop-cutting Experiments and a Survey of Public Opinion and Listeners' Reaction to Broadcasting in India. The Hon'ble Mr. Nalini Ranjan Sarker, Member-in-charge of the Department of Education, Health and Lands, Government of India, was elected President for the year 1942-43. Prof. P. C. Mahalanobis was re-elected Hon. Secretary of the Institute and Prof. K. N. Chakravarti and Mr. K. R. Nair were elected Hon. Joint-Secretaries.

Fisheries Technological Institute, Tuticorin.—The opening of a Fisheries Technological Institute at Tuticorin had been engaging the attention of the Government since 1932. Early in 1932, the *Baratha Mahajana Sangam*, Tuticorin,

presented a Memorial to the Government, requesting the establishment of a school at Tuticorin, which will impart to the students of the fishermen community, improved methods of catching and preserving fish as well as impart them education in Navigation. This materialised in the establishment of the Institute at Tuticorin in 1942. The Institute provides for the training of teachers in Fishery Technology after their regular course in the Teachers' Training Schools. It also provides courses of instruction to the fishermen and the public in all branches of the fishing industry including Navigation.

The Institute has three courses of studies. The first course is training in Fisheries Science to the Trained Teachers. The course is for one year. The subjects taught under Fisheries Science are Biology, Fishery Technology, Socio-Economics and Navigation. The Trained Teachers are given training in Carpentry also. Usually, teachers possessing Higher Grade Elementary Training Certificate are admitted. The second course is Navigation Course. Sons of fishermen are given training in sculling, signalling, stitching of sails, handling of ropes and sailing of small vessels. The Institute has a model Dummy Top sail schooner to acquaint the candidates with the riggings and shrouds of a square rigged sailing ship. The object of the training is to train the boys in duties pertaining to lower deck so that they may sit for the Board of Trade Examination after the requisite service in the sea. This course is for three years. The third course is a short course in Fishing industry for persons who intend to trade in fish such as Fish curing, Fish meal manufacture and Fish canning and other allied fishing industries.

The medium of instruction for all the three courses is Tamil.

The Board of Industries and Commerce in Mysore met on 23rd March 1942 under the Presidency of Rajasevaprasakta Mr. A. V. Ramanathan, B.A., Minister for Law.

The report of progress made in regard to pending subjects since the last Board Meeting held on 9th September 1941 was reviewed by the Board. The progress made on the several schemes was explained by the concerned officers.

The Board supported the recommendation of the Board of Industrial Planning and Co-ordination that a competent medical graduate be appointed for study of the incidence of the several occupational diseases among industrial employees in the State.

The manufacture of a suitable starch in place of sago flour, which is one of the main ingredients used in the sizing mixture in the textile trade and which is difficult to import now owing to the international situation, was considered and the matter was referred to the Director of Industries and Commerce for further investigation.

Soil Investigation in Sind.—An investigation scheme to determine the soil and sub-soil conditions in the Lloyd Barrage Zone has been approved by the Imperial Council of Agricultural Research.

Sixteen stations, scattered throughout Sind, have been established for the purpose and already over 3,000 soil samples have been examined in regard to their texture, salt content, base exchange capacity and other physico-chemical properties.

The scheme is for three years and a full report will be published after fully analysing the data.

Moos Gold Medal.—Professor Maneck B. Pithawalla, D.SC., F.G.S., of Karachi, has been awarded the Moos Gold Medal by the University of Bombay for the best thesis on scientific research for the year 1940-41.

Lady Tata Memorial Trust.—The Trustees of the Lady Tata Memorial Trust announce the awards of the following Scholarships and Grants for the year 1942-43:

A. INTERNATIONAL AWARDS for research in diseases of the blood with special reference to Leucæmias:—(1) Dr. Jacob Furth, Cornell University Medical College, New York, (£400). (ii) Dr. P. A. Gorer, Guys Hospital, London, (£70). (iii) Dr. A. H. T. Robb-Smith, Oxford University, (£300). (iv) Dr. Werner Jacobson, Strangeways Research Laboratory, Cambridge, (£300). (v) Dr. Sybil Williams, Cambridge, (£350). (vi) Prof. Doljanski, Jerusalem (£400).

B. INDIAN SCHOLARSHIPS of Rs. 150 per month for one year from 1st July 1942 for scientific investigations having a bearing on the alleviation of human suffering:—(1) Mr. S. Rajagopalan, M.SC., Haffkine Institute, Bombay. (ii) Mr. N. C. Datta, M.SC., Haffkine Institute, Bombay. (iii) Mr. K. Ramamurthi, M.A., B.SC. (HONS.), University Biochemical Laboratory, Madras. (iv) Miss Mary Samuel, B.A., M.SC., University Zoological Laboratory, Madras. (v) Miss Beatriz de Menezes Braganca, M.SC., University College of Science, Calcutta. (vi) Mr. Sudhir Ranjan Das, M.SC., Bose Research Institute, Calcutta. (vii) Mr. M. V. Lakshminarayana Rao, M.SC., Indian Institute of Science, Bangalore.

University of Dacca.—At the meeting of the Executive Council held on the 6th February 1942, it was resolved "That students on transfer certificates from the University of Calcutta be admitted to this University provided they have kept up the required percentage prescribed by the regulations of the Calcutta University and that their cases for condonation of shortage of attendance or residence be sympathetically considered only if they fulfil the ordinances regarding residence and attendance in this University in respect of the period subsequent to 21st January 1942." It was further resolved "That subject to the passing of the necessary validating Act, Statutes and Ordinances by competent authorities, students from Burma, Malaya and from areas which in the opinion of the University are affected by the War, who have completed their courses, may be permitted to take the examinations of this University provided their guardians certify that they have completed the courses and were eligible for corresponding examinations in their own University. Further, that students from the same areas may be admitted to this

University in any course on similar certificates from their guardians and in this case this University would be prepared to recognise the period spent by them in their own colleges, for purposes of completing their studies in this University. Provided that any privilege that may be conferred upon such students including the award of diplomas or degrees, is liable to be withheld or revoked if any statement made by the students or their guardians cannot be later substantiated by proper official records issued by competent authorities; and that subject to the above principles, the Vice-Chancellor be authorised to deal with cases for admission coming from Burma, Malaya or other Universities."

University of Delhi.—The extension of the degree course from two to three years is part of the general scheme of reconstruction of higher education in Delhi which has been accepted by the University as well as by the Government of India. The scheme includes *inter alia* three fundamental principles, briefly indicated as follows:—(1) The abolition of the Intermediate Examination, (2) the extension of the High School Course by one year (*i.e.*, extension of the School Course from 10 to 11 years), and (3) the institution of a three-year degree course in the University.

The stage of admission to the University has been a difficult problem for a long time as the present standard of the Matriculation or the High School Examination is not sufficiently high for direct admission to the three-year degree course of the University. The Government of India have, therefore, decided to carry out, in the immediate future, a complete reorganization of Secondary Education in Delhi by improving the High Schools, by extending the School Course by one year (*i.e.*, from 10 to 11 years) and by raising the standard of the High School Examination, so that it may be recognized by the University as a Qualifying Test for admission to a three-year degree course.

MAGNETIC NOTES

May 1942 was comparatively less disturbed than the previous month. There were 15 *quiet* days, 15 days of *slight* disturbance and one day of *moderate* disturbance as against 5 quiet days, 22 days of slight disturbance and 4 of moderate disturbance during May 1941. The day of largest disturbance during May 1942 was the 14th and the quietest day was the 13th. The classification of the characters of individual days was as follows:—

Quiet days	Disturbed days	
	Slight	Moderate
3, 7-9, 12, 13, 16–19, 21, 25, 26, 30, 31.	1, 2, 4–6, 10, 11, 15, 20, 22–24, 27–29.	14.

No magnetic storm was recorded during the month of May 1942, while a moderate storm was recorded during the same period of last year. The mean character figure for the month was 0·55 as against 0·97 for May 1941.

M. R. RANGASWAMI.

SEISMOLOGICAL NOTES

During the month of May 1942 one great, two moderate and seven slight earthquake shocks were recorded by the Colaba seismographs as against one feeble, three slight and three moderate ones recorded during the same month in 1941. Details for May 1942 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
		H.	M.	(Miles)		(Miles)	
5	Slight	09	01	340	..	..	
14	Great	07	43	10210	..	..	
15	Slight	19	44	460	..	..	
15	Slight	22	25	1270	..	..	Epicentral region probably in the Hindu Kush mountains.
23	Slight	07	47	1050	..	..	
24	Slight	01	32	690	..	..	
24	Moderate	08	57	1890	Near Lat. 4°·5 N., Long. 96°·5 E. in Sumatra.	..	
27	Slight	09	04	790	..	..	
28	Moderate	06	31	3930	..	190	
28	Slight	20	50	1450	..	..	

ASTRONOMICAL NOTES

The earth will be in aphelion on July 6.

Planets during July 1942.—Mercury should be easily observable in the morning sky during the first half of the month, the greatest western elongation from the Sun (21° 23′) being reached on July 6. Venus continues to be visible as a fairly brilliant star in the morning twilight; it is moving slowly towards the Sun and gradually getting fainter. Mars will be approaching the Sun in the evening sky and rapidly fading in brightness and will not be in a favourable position for observation for the remaining part of the year.

Jupiter and Saturn are both morning stars; the former will, however, be too near the Sun to be easily visible until the end of the month. Saturn is moving slowly eastwards in the constellation Taurus; on July 4 will occur a close conjunction of this planet with Venus, the angular distance between the two objects at the time of nearest approach being only about 4 minutes of arc. An occultation of some importance that will be visible in this country is that of the first magnitude star Aldebaren (α Tauri) occurring on July 10.

One of the prominent meteoric showers—the Detta Aquarids—have their maximum display about July 28. The position of the radiant point in the sky is given by R.A. 340° Declination 12° South and the meteors of this group are known to have slow long paths.

T. P. B.

ANNOUNCEMENT

The Sugar Technologists' Association of India.—It has been tentatively decided to hold the *Eleventh Annual Convention of the Sugar Technologists' Association of India* in Cawnpore, in conjunction with the Annual General Meeting of the Indian Sugar Mills Association, in the month of September 1942.

Papers dealing with original researches, new designs, calculations and new applications of known processes and equipments and also on subjects of technical and general interest to the Indian Sugar Industry, *e.g.*, agriculture, cane diseases and pests, sugar manufacturing processes, chemical control, etc., will be received by the Secretary upto the 30th June 1942. All members of the Association and others connected with the Industry are requested to contribute papers and may please intimate the Secretary as to the number of papers they are likely to contribute.

* * *

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 90, Nos. 4606 and 4608.

"Journal of Agricultural Research," Vol. 64, Nos. 3-4.

"Indian Journal of Agricultural Science," Vol. 12, Pt. 2.

"Biochemical Journal," Vol. 35, Nos. 10 & 11.

"Biological Reviews," Vol. 17, No. 1.

"Journal of Chemical Physics," Vol. 10, No. 3.

"Journal of the Indian Chemical Society," Vol. 19, No. 3.

"Experiment Station Record," Vol. 86, No. 3.

"Indian Forester," Vol. 68, No. 6.

"Transactions of the Faraday Society," Vol. 38, Parts 2 and 3.

"Indian Farming," Vol. 3, No. 5.

"Indian Central Jute Committee (Bulletin)," Vol. 5, No. 2.

"Review of Applied Mycology," Vol. 21, Pt. 2.

"The Mathematics Student," Vol. 9, No. 4.

"Bulletin of the American Meteorological Society," Vol. 22, No. 10; Vol. 23, No. 1.

"Indian Medical Gazette," Vol. 77, No. 5.

"Journal of the Bombay Natural History Society," Vol. 43, No. 1.

"Journal of Nutrition," Vol. 23, Nos. 1-3.

"Nature," Vol. 149, Nos. 3770-72, 3774-76.

"Journal of Research (National Bureau of Standards)," Vol. 27, No. 6; Vol. 28, Nos. 1-2.

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THE PHYSICS OF THE DIAMOND

By reason of its remarkable properties, diamond is a substance of extraordinary interest to the physicist interested in the study of solids. It exhibits in a characteristically striking fashion, many phenomena which are scarcely noticeable with other solids in ordinary circumstances. As an instance, we may recall the variation of specific heat with temperature. This was known as an experimental fact in the case of diamond for at least fifty years before it was recognised as a universal property of the solid state; the data for diamond published by Weber in 1875 formed the basis of Einstein's epoch-making paper of 1907 introducing the quantum theory of specific heats. History has a way of repeating itself, and the study of diamond should therefore appeal strongly to the experimenter seeking new avenues of research and to the theorist seeking new and fruitful lines of physical thought concerning the solid state.

For the reasons stated, I have since the year 1930 been deeply interested in physical investigations on the diamond. The difficulty of obtaining the material in a form suitable for exact studies has, however, been a serious obstacle to progress. Indeed, in the early days, I was reduced to the expedient of borrowing diamond rings from wealthy friends who, though willing to oblige, were slightly apprehensive about

the fate of their property! More recently, these difficulties have diminished as the result of the discovery that flat plates of diamond of excellent quality are not very expensive and can be purchased in useful sizes from many jewellers in India. The collection of diamonds got together in this way has enabled studies with this crystal to figure prominently in the Bangalore researches on the solid state. Results of fundamental importance have been reached by spectroscopic investigations on light-scattering, on absorption in the visible and ultra-violet, on fluorescence and phosphorescence, and by X-ray studies on numerous diamonds. It is no exaggeration to say that the experimental facts revealed by these researches have opened up a completely new view of the physics of the crystalline state.

My knowledge of diamonds in their natural condition has improved and my personal collection of material for study has been notably enlarged, following a visit by me to the State of Panna in Central India where diamond-mining and diamond-working have been carried on since ancient times. I carried with me to Panna, a microscope, a strain-viewer, an ultra-violet lamp and a small quartz spectrograph. With the aid of this apparatus and with the kind co-operation of Mr. Balkrishna who is Director of Industries in the State, Mr. Nayar and myself were enabled to examine several hundred diamonds in their natural condition. We were also graciously permitted by His Highness the Maharaja of Panna to examine his famous garland of 52 large diamonds strung together in their natural state as crystals. The 25 uncut diamonds I purchased and brought back to Bangalore form a representative collection chosen for their scientific interest. There is little doubt that their detailed examination will yield a rich harvest of results.

2. The Crystal Forms of Diamond

The reports on the diamond deposits in the Panna State published by E. W. Vredenburg (1906) and by K. P. Sinor (1930) include a good deal of information of interest to the physicist and crystallographer. Sinor has a whole chapter in his book, accompanied by drawing and illustrations, concerning the physical characters of the Panna diamonds. Personal observation, however, is necessary to enable one to appreciate the remarkable beauty of these diamonds in their natural condition. With their exquisitely perfect geometric form and their smooth lustrous surfaces, they look absolutely fresh from Nature's crucibles, though actually taken from sedimentary formations which according to the geologists, are a thousand million years old. The strongly-marked curvature of the crystal faces and smoothly rounded edges of the octahedral forms are a surprising feature of these crystals. It is clear, however, from the symmetry of shape, the smoothness of the faces and the fact that forms more complex than the octahedron are represented by sharp edges that the diamonds as we now see them are exactly in the same state as when they were first formed.

I wish to put forward tentatively a suggestion which seems to me to offer a reasonable interpretation of the facts stated above. If carbon liquefied under suitable

conditions of temperature and pressure when surrounded by molten silicious material, the form of the drops of the liquid diamond would be determined by the interfacial tension and would be spherical, provided the valence bonds between the atoms of carbon in the liquid were oriented completely at random. If, however, some measure of regularity in the orientation of the valence bonds could be assumed, the conditions within the liquid would roughly approximate to those in the solid crystal; in other words, *diamond in the molten state would be a liquid crystal.* The interfacial tension would then vary with direction and the surfaces of minimum energy would not be spherical, but would tend to show some resemblance to the forms exhibited by a cubic crystal. If the shapes assumed by diamond in the liquid crystalline state persisted on solidification or else suffered only minor changes, we would have an explanation of the forms now observed.

3. Accidental Birefringence in Diamond

Mr. Sinor examined many of the Panna diamonds under the polarisation microscope and writes as follows:—"*Very clear crystals in which all the faces were symmetrically developed showed very little or no double refraction. Crystals full of flaws and inclusions and distorted crystals showed the colour bands very well.*" This important finding agreed with the observations made by Mr. Nayar and myself at Panna with numerous diamonds placed between the nicols of a simple strain-viewer. It has since been fully confirmed by careful observations under the polarising microscope made at Bangalore with the 25 Panna diamonds, the disturbing effects produced by their external surfaces being eliminated by immersion of the specimens in a highly refractive liquid.

The absence of birefringence in clear and symmetrically developed diamonds and its presence in defective and distorted diamonds are precisely what we should expect if a liquid crystalline condition of molten carbon preceded the formation of solid diamond. If the fluid material attained complete uniformity as well as mechanical and thermal equilibrium with its surroundings before solidification, a homogeneous crystal would have formed, while if it did not, the resulting solid would exhibit a lack of homogeneity with consequent development of internal stresses and strains manifesting themselves in an observable birefringence. On this view, the birefringence when observed is essentially a macroscopic effect which does not differ in its physical nature from the birefringence artificially produced by the imposition of external stress on a homogeneous crystal. This interpretation is supported by the fact that the restoration of light is most strongly marked in the vicinity of visible flaws and defects and that by cleaving off the defective parts, the rest of the material may be freed from strain, with the result that the birefringence in it disappears. I have in my collection a plate of diamond which was cleaved into two pieces: as the result of the cleavage, one part was freed from birefringence and is now perfectly dark between crossed nicols, while the other part continues to show a marked restoration of light. It is clear from all these facts that the belief entertained by some writers that a condition of

strain is an inherent characteristic of diamond is completely without foundation.

Examination of the specimens in my collection also shows the lack of foundation for the idea which has gained currency in the literature that diamonds whose transparency extends into the ultra-violet beyond 3000 Å are strain-free, while those which transmit radiations only up to 3000 Å are subject to strains. Actually, I have several specimens of the less transparent variety which appear quite dark between crossed nicols, while the four plates of the more transparent kind in my possession all exhibit an intense restoration of light when viewed under the polarising microscope.

4. The Scattering of Light in Diamond

Beliefs in arbitrary or artificial hypotheses, however plausible they may appear, is contrary to the spirit of science which should rely rather on well-ascertained facts of observation as the foundation of its activities. Galileo when he made his famous experiment of dropping weights from the leaning tower of Pisa, showed the way to deal with all such *ad hoc* beliefs, namely, to confront them with the results of a direct experimental test. Diamond which is the prince of crystalline solids gives us the means of making such tests of the assumptions on which Debye's theory of specific heat and the so-called lattice theory of Born are based.

The spectroscopic examination of the light scattered by a crystal when it is traversed by a beam of monochromatic radiation is perhaps the simplest of the experimental methods available for investigating the possible modes of atomic vibration in a crystal. Diamond is readily examined in this way and yields very interesting results. Even with tiny diamonds, the spectroscope records a remarkably intense and perfectly sharp line displaced from its parent radiation by 1332·1 wave-numbers at room temperature. Bhagavantam (1930) has shown that this line is many times more intense than the sharp bright line with a displacement of 992 wave-numbers observed with benzene which arises from the symmetric vibrations of the carbon ring. Using an exceptionally fine and clear diamond 20 carats in weight, he also recorded several other comparatively faint lines, their wave-number shifts being 1158, 1288, 1382, 1431, 1480, and 1585. More recently, Nayar (1941) has studied the scattering of light in diamond over a wide range of temperature and finds that the principal line remains sensibly sharp over the whole range from 83° T to 1130° T; its frequency-shift, however, falls from 1333·8 at the lowest to 1316·4 at the highest temperature of observation.

The appearance of no less than seven discrete frequencies as sharp lines in the spectrum of such a simple crystal as diamond is not easy to reconcile with the ideas underlying the Debye and Born theories of the solid state. If we lay aside the preconceived notions underlying these theories, the plain reading of the experimental facts is that the infra-red vibration spectrum of diamond is essentially similar to that of a polyatomic molecule and consists of discrete monochromatic lines. The experiments do not offer any *prima facie* support for the assumption inherent in the theories of

Debye and Born that the lattice spectrum is a continuous one.

5. The Blue Fluorescence of Diamond

The experimental situation becomes even clearer in the light of the facts revealed by the recent studies of Nayar (1942) of the blue fluorescence spectrum of diamond and of the corresponding absorption spectrum observed with the crystal held at liquid air temperature. Both in fluorescence and in absorption, diamond when so cooled down exhibits a close doublet centred at 4152 Å in the spectrum, the same appearing bright in fluorescence and dark in absorption. Spreading out towards lower frequencies in fluorescence and towards higher frequencies in absorption, appears depicted the lattice spectrum of diamond; this is located with perfect mirror-image symmetry of frequency respectively on the two sides of the 4152 doublet. Even at liquid air temperature, the width of the 4152 band is sufficiently small to enable the details of the lattice spectrum to be seen clearly resolved. No fewer than 19 discrete frequencies can be made out, the values derived from the fluorescence and absorption spectra being in complete agreement. These frequencies range from 1387 wave-numbers down to 178 wave-numbers, and include (within the limits of experimental error) those found by Bhagavantam from his studies on light-scattering in the same region.

Three distinct methods of spectroscopic study, namely, scattering, fluorescence, and absorption, thus agree in indicating that the lattice spectrum of diamond is essentially similar to that of a polyatomic molecule, consisting of a series of discrete monochromatic frequencies. The experimental facts are evidently irreconcilable with the

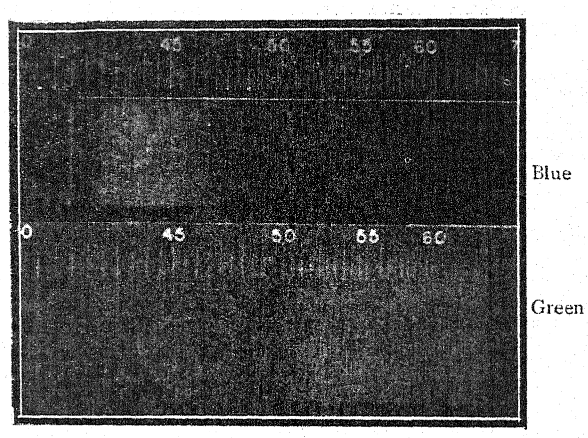

Fig. 1
Blue and green fluorescence spectra

basic ideas of the Debye and the Born theories of the solid state according to which the diamond lattice should have a continuous spectrum of frequencies.

6. X-Ray Reflections of the Second Kind

The spectroscopic evidence showing that the vibration spectrum of diamond consists of discrete monochromatic frequencies has very important consequences for the X-ray physics. Since diamond has a rigid structure which is a three-dimensional repeating pattern in space, each of the possible vibrations of this structure must be assumed to occur in the same way in all the volume elements chosen as the units of the space-pattern, since otherwise we would have an infinite number of possible frequencies, instead of a finite number of discrete vibrations as actually observed. In other words, a diamond in which the atoms oscillate with any one of its infra-red frequencies continues to be a three-

dimensionally periodic structure in space. Thus, for the same reason which enables the crystal planes of the static crystal to give the well-known Laue and Bragg reflections of unaltered frequency, the crystal planes of the vibrating crystal should also give dynamic reflections with altered frequency.

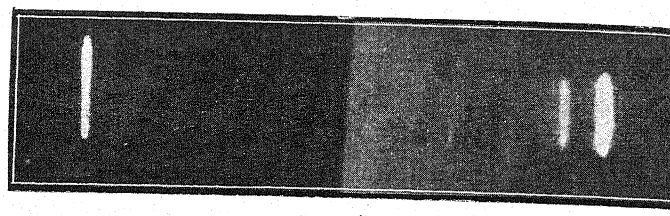

FIG. 2
The triple quantum X-ray reflections

It has been shown by Dr. Nilakantan and myself that the (111) crystal planes in diamond do exhibit dynamic X-ray reflections of the kind indicated above and that their characters as actually observed in experiment, namely, their perfectly specular sharpness, the geometric law which they follow and their practical independence of temperature, can only be understood if they are associated with the high-frequency infra-red vibrations of the crystal structure in the manner suggested. Indeed, exact experimental studies have confirmed this view of their origin in a most remarkable and complete fashion. In particular, it may be remarked that the theory indicates that corresponding to the principal or 1332 vibration of the diamond lattice, the (111) planes should give *three* quantum reflections and not one, the geometric position of these varying with the setting of the crystal, being strictly calculable when it is known. The beautiful confirmation of this prediction furnished by the experiments is illustrated in the accompanying Laue diagram obtained by R. V. Subramanian, where the three quantum-reflections appear as sharply defined lines in displaced positions on one side of the usual Laue reflection.

An important feature of the new X-ray reflections observed with diamond is that the crystal-spacing associated with such reflections, if calculated on the basis of the ordinary Bragg formula, is not constant but varies rapidly with the setting of the crystal. It is also a function of the wave-length of the X-rays employed. Further, the orientation and azimuth of the plane in which the reflections are observed are also dependent on the setting of the crystal and the wave-length of the X-rays. These facts and especially the existence of three simultaneous reflections in geometric relation to each other are in complete accord with the dynamic view of their origin. It is evident, on the other hand, that attempts to explain away these phenomena by *ad hoc* assumptions, *e.g.*, an arbitrarily postulated inherent static "strain" in diamond are wholly inadmissible and indeed quite meaningless. It should be emphasised also that the perfect sharpness at all settings of the crystal exhibited by these reflections excludes any attempt to explain them as due to the disturbance of the crystal lattice by vibrations of the kind assumed in the Debye and Born theories of the solid state.

7. The Lattice Spectrum of Diamond

The spectroscopic and X-ray results obtained with diamond and briefly summarised above thus compel us to reject the Debye and Born theories as incompatible with the facts. We may summarise the experimental

situation by stating that the possible vibrations of the crystal lattice of the diamond are spectroscopically similar to those of a polyatomic molecule, while geometrically they must be considered as repeating themselves in space with three-dimensional periodicity. A simple way of reconciling these results is to regard the entire crystal as an aggregate of interpenetrating space-lattices of a very simple kind, and to assume that these lattices oscillate as rigid wholes relatively to each other, while their common centre of gravity remains at rest. Such an oscillation would cause the structure of the crystal to vary with time periodically, while retaining its perfect three-dimensional periodicity in space. This picture is, however, only an idealisation, since the X-ray results show that a slow variation of phase of the lattice oscillation at different parts of the crystal is permissible.

The crystal structure of diamond is well-known, and the various possible normal modes of vibration of the lattice which can arise in this way can therefore be theoretically ascertained. Their frequencies can also be calculated in terms of the force resisting the movements of the carbon atoms, namely, those involved in an alteration of the length of the valence bonds and those resisting a change of the angles between them. The lattice spectrum of diamond can thus be theoretically worked out and compared with the experimental data. In particular, it becomes clear that the vibration having a frequency of 1332 wave-numbers is that in which the adjacent planes of carbon atoms parallel to the (111) faces of diamond alternately approach and recede from each other. It is readily understood

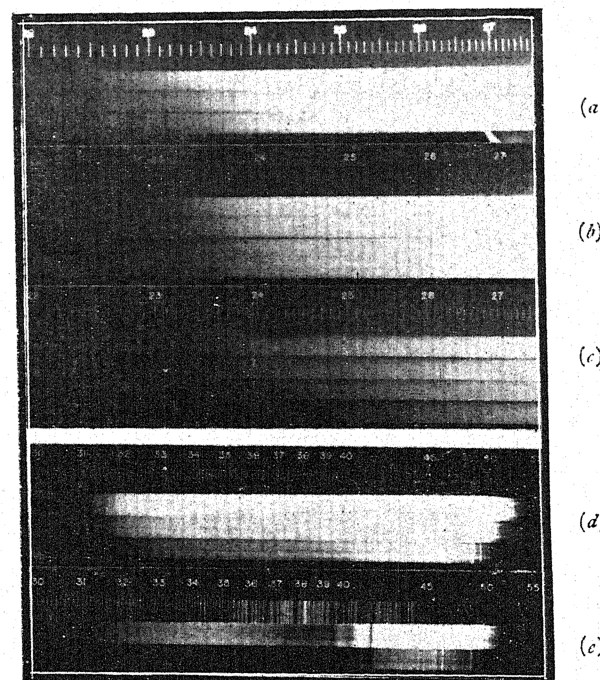

FIG. 3
The absorption spectra of different diamonds

why such an oscillation results in an intense reflection of the X-rays with altered frequency by those planes. Other lattice frequencies observed in the fluorescence spectrum may be similarly identified as various types of oscillations relative to each other of the atomic planes parallel or perpendicular to important faces of the diamond, *e.g.*, the cube, the octahedron and the dodecahedron. A complete account of the X-ray phenomena exhibited by diamond would include a detailed consideration of the effects of each of these possible modes of oscillation on the lattice planes capable of giving sufficiently strong X-ray reflections.

8. The Absorption Spectrum of Diamond

It has already been mentioned that the blue fluorescence of diamond is associated

with a corresponding absorption in the violet and near ultra-violet regions of the spectrum. The intensity of this fluorescence and of the corresponding absorption varies enormously from diamond to diamond, though their spectral characters remain otherwise sensibly the same. For instance, in a small octahedral diamond in my possession, the 4152 band is only recorded after extremely prolonged exposures. The fluorescence, when present, is accompanied by phosphorescence in the green, yellow and red regions of the spectrum. Several of the Panna diamonds in my collection, on the other hand, show an intense fluorescence in the green, yellow and red regions, the blue fluorescence though present being weak in comparison. There are other diamonds again which show both the blue and green fluorescence in roughly comparable intensities.

These remarkable variations in the luminescence properties of diamond appear to bear a relation, not yet fully elucidated, to the equally obvious variations in the transparency of diamonds in the visible and ultra-violet regions of the spectrum. So far as transparency in the ultra-violet is concerned, Mr. Nayar's studies show that at least *three* distinct kinds of variation should be recognised, as they are accompanied by clearly recognisable features in the absorption spectra. *The first and most transparent kind of diamond* has a sharp cut-off at about 2250 A.U. in the ultra-violet. The *second type* has a clearly marked absorption band at about 2370 A.U. followed by a very feeble transmission at shorter wave-lengths. The *third type* has a cut-off at about 3000 A.U., accompanied by subsidiary absorption bands at longer wave-lengths. The majority of diamonds appear to belong to the third type, a characteristic of which is the emission of the blue fluorescence with greater or less intensity. It is noteworthy also that some diamonds exhibit simultaneously more than one or even all the three types of spectroscopic behaviour. A continuous transition between the three types of behaviour is thus shown to be possible. The ultra-violet absorption of the third or ordinary type has been pretty fully investigated by Nayar. No fewer than some 25 sharply defined electronic absorption frequencies have been recorded by him between 3000 A.U. and 3600 A.U. at liquid air temperatures.

9. Concluding Remarks

It will be obvious from what has been stated above that the investigation of the physics of the diamond is full of promise for the future. I have made no reference in this article to further results of great interest which have been obtained but which could not appropriately find a place in a general account of the subject. I may, however, briefly mention the progress which has been made in the study of the relations between the spectroscopic behaviour of different specimens of diamond and the X-ray phenomena exhibited by the same specimens. It is sufficient here to remark that the results obtained in this connection do not in any way contradict the broad results stated above, but on the other hand afford them the fullest support.

C. V. Raman.

PULSATIONS OF VARIABLE STARS

BY

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ASTRONOMERS are of the opinion[1] that the standard type of a variable star has approximately a spherical symmetry, and any observed phenomenon will look the same from all directions and will not depend on the position of the observer. So the rotational theory of Jeans[2] suggesting that changes in brightness depend on the rotation of a pear-shaped body is ruled out, as a pear-shaped figure has no spherical symmetry. Moreover from spectroscopic observations we find that Cepheid Variables show the strange phenomenon of lurching towards us when they are bright and away from us when they become faint. The accepted interpretation of this phenomenon first suggested by Shapley is that Cepheid Variables pulsate. This theory now holds the field as the best working hypothesis.

Cepheids are also giant stars, and according to Gamow,[3] the pulsation phenomenon observed for Cepheid Variables is due to "instability during the transition from the giant branch into the main sequence". Gamow further opines that "the energy production in ordinary Cepheids is due to hydrogen reactions with lithium, beryllium, and boron (for different values of periods) whereas the only source of energy in the long-period variables is given by the reaction between hydrogen and deuterium".

Eddington[4] considered small radial oscillations of a variable star conforming to the standard model of polytropic index 3, which are symmetrical about the centre and the square of whose amplitude could be neglected. The oscillations were assumed to be adiabatic. Sterne[5] has considered specific cases of small radial oscillations of a star of uniform density and also of a star in which the density varies inversely as the square of the distance from the centre up to a very small distance from the centre within which the density is constant. He neglected the square of the amplitude. It is found that only a sequence of modes of oscillations is possible in these cases.

The author[6] has investigated possible modes of oscillations by retaining the square of the amplitude in the differential equations. He has considered two models of a star, *viz.*, (1) a star of uniform density and (2) a star in which the density varies inversely as the pth power of the distance from the centre (where p is a positive integer excluding 1 and 3), except in a small finite core of constant density surrounding the centre. In both the cases it is found that the amplitude increases and becomes infinite at the boundary of the star, and consequently no mode of radial oscillations is possible. If we assume spherical symmetry for the star, p can have only even integral values; so we can exclude the values 1 and 3. Following the method of the author, H. K. Sen[7] has more recently shown that the solutions of the differential equations would be divergent at the boundary of the star for values of p greater than 3 even if we neglect the square of the amplitude. For $p = 2$ the oscillations would be stable only for a vanishing central core. In this case there will, however, be a singularity at the centre. To avoid this, Sen[7] has taken the following laws of density: (1) $p = a - br$ and (2) $p = a - br^2$. He has found that the radial oscillations are unstable. So we are led to the conclusion that our pulsating stars should be more or less homogeneous. The necessity for the Cepheids to be more homogeneous than "ordinary stars" has been emphasised by Eddington.[8] According to Chandrasekhar,[9] "the Cepheids and the Cluster-type Variables which occur in the "super-giant" region of the Hertzsprung-Russell diagram must be much less concentrated towards the centre than the typical main series stars". Kopal[10] opines that "with advancing spectral type the central condensations of stars seem rapidly to diminish, and the δ Cephei-F5 stars seem to approach the limit of homogeneity". So there is a unanimity of opinion among the astrophysicists that the Cepheids are more homogeneous and much less centrally condensed than the typical main series stars. Dynamically we have also come to the same conclusion.

The author has shown[6] that a passing star may bring about some sort of resonance phenomenon by increasing the amplitude of pulsation through tidal influence and

thereby making the system unstable. The author's Cepheid theory of the origin of the Solar System has already been explained by H. K. Sen in a recent note to *Current Science*.

When a star is rotating about an axis through its centre, it assumes more or less an oblate spheroidal form. It has been found that a sequence of modes of small radial oscillations is possible for a slowly rotating oblate spheroidal Cepheid of small ellipticity if we retain terms only up to the order of the square of the angular velocity.[7] If due to loss of radiant energy the Cepheid begins to contract, the angular velocity would increase and the star would assume a more and more oblate shape causing an appreciable departure from homogeneity. The amplitude would increase, and the oscillations would become unstable. The Cepheid would then break up by fission[11] into two comparable, approximately homogeneous masses. This would give birth to a double star system. On the other hand, we have seen[6] that a passing star due to its tidal influence would help in the formation of a planetary system out of a pulsating Cepheid variable. It is significant that Kopal's investigations[12] have led him to conclude that "the components of a new-born binary are homogeneous or nearly so".

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2 Jeans, J. H., "Astronomy and Cosmogony," 1929, p. 388.

3 Gamow, G., *Phys. Rev.*, 1939, **55**, 718.

4 Eddington, A. S., "The Internal Constitution of the Stars," 1926, pp. 186–208.

5 Sterne, T. E., *M.N.*, 1937, **97**, 582.

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7 Sen, H. K., "Radial oscillations of a variable star"; "Adiabatic pulsations of the Cepheid variable"; and "Radial oscillations of a slowly rotating star". Communicated to the *Nat. Acad. Sc. India.*

8 Eddington, A. S., *M.N.*, 1932, **92**, 480.

9 Chandrasekhar, S., *ibid.*, 1936, **96**, 656.

10 Kopal, Z., *ibid.*, 1938, **99**, 38.

11 Jeans, J. H., "Astronomy and Cosmogony," 1929, p. 266.

12 Kopal, Z., *M.N.*, 1936, **96**, 862.

SUGAR INDUSTRY OF INDIA, 1939–40*

THE year 1939-40 was an eventful one for Indian Sugar Industry. An excellent crop, a higher ruling price for sugar, and a longer duration of milling season in the U.P. and Bihar resulted in a high record for sugar production. The fixation of a minimum selling price for all grades of sugar by the Indian Sugar Syndicate and a poor demand for sugar in the early part of the season led to the accumulation of abnormally heavy stocks in factory go-downs and the situation was not eased until the Government withdrew the recognition of the Syndicate. Subsequently, however, the Syndicate was re-recognised subject to some conditions. The Syndicate's action in lowering the basic and the selling prices, and the Government's announcements regarding the restriction of output in the year 1940-41 improved the demand for sugar. During this season a sliding scale connecting the cane prices with the prevailing sugar prices was also instituted.

The total area planted with sugarcane this year was 3,619,000 acres which shows an increase of 16 per cent. over the previous year's planting. Leaving Bihar, Assam, Orissa and the C.P., the weather conditions in other cane tracts were not quite favourable.

Out of a total of 158 sugar factories existing in India, 145 worked during the season 1939-40 and produced 1,241,700 tons of sugar which is the highest record production for the industry in India, the previous record being 1,111,400 tons in 1936-37. The short production of sugar in 1938-39 necessitated very heavy imports from Java which took place in the official year (April-March) 1939-40. The quantity of sugar available for consumption in the year under review has been estimated at 1,074,000 tons.

The net production of gur in India in 1939-40 was 2,441,000 tons which is about 15 per cent. in excess of the production in the previous year. The production of molasses in the country was 485,300 tons by cane factories, 16,900 tons by gur refineries and 125,000 tons by khandsaris. Therefore the total production was about 625,000 tons as against 349,000 tons in the previous year.

The rate of excise duty of sugar was raised from Rs. 2 to Rs. 3 per cwt. and correspondingly the import duty on sugar became Rs. 9-12-0 as against Rs. 6-12-0 in the previous year.

The chief feature of Indian sugar industry at present is the large extent of Government control to which it is subjected specially in the U.P. and Bihar. In these provinces the industry has voluntarily submitted itself to this control. In almost all important sugar-producing countries this industry is subject to some form or other of Government control but in the U.P. and Bihar this control is exercised on established lines that have been tried with success elsewhere.

G. GUNDU RAO.

* Review by R. C. Srivastava, *Supplement to the Indian Trade Journal*, May 7, 1942.

A TEST OF SIGNIFICANCE FOR MULTIPLE OBSERVATIONS

BY

PROF. D. D. KOSAMBI

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1. A test of significant discrimination between two sample-groups of multivariate observations can be made by Hotelling's extension[1] of Student's t-test; by R. A. Fisher's discriminating function[2] based on the multiple correlation coefficient; the generalized distance[3] of Mahalanobis, Bose and Roy. In addition to these closely related T^2, R^2, D^2 tests, Wilks[4] has suggested others which would not involve the group means entering into the first three; but these last, as well as D^2 necessitate new sets of tables. For the case of two variates, however, it has been shown[5] that the usual analysis of variance can be carried out exactly, using the z-tables of Fisher, provided the degrees of freedom are suitably readjusted.

Here, I propose to extend the z-test partially to samples drawn from a normally distributed population in $p > 2$ linearly independent variates. I also consider briefly the limiting case in which the number of variates increases beyond any limit, which leads us to discrimination between samples consisting of sets of whole curves. This has the advantage of theoretical simplicity, in that all finite dimensional normal distributions are special cases, in much the same way as polygonal area rules like Simpson's come under the general $\int ydx$ formula. If accepted, the method would extend analysis of variance to such material as electrocardiograms, cranial shapes, temperature curves and the like. It is emphasized that the discrimination is performed by the best linear combination of the old variates, and not by the characteristic roots as such that appear in the process.

The contents of the opening chapters of Courant-Hilbert: *Methoden der Mathematischen Physik I* (1931) are taken for granted in the deduction.

2. We use the tensor summation convention: a repeated index denotes summation over all possible values of the index. The variates 1, 2, ..., p are indicated by Greek indices; sampling values 1, 2, ..., n of each variate by an additional Latin index. Thus $x_{\nu i}$ is the ith sample value of the νth variate. Without loss of generality, the population mean for each variate is taken as zero. The multivariate normal distribution has then the probability density $c\ exp\text{-}\phi/2$ where ϕ is a positive definite quadratic form in the p variates, c a constant so chosen as to make the total probability over the whole p-space equal to unity.

There exist infinitely many linear homogeneous transformations of the variates reducing ϕ to a sum of squares:

$$\phi = \sigma^{\alpha\beta} x_\alpha x_\beta = \delta^{\alpha\beta} y_\alpha y_\beta;$$
$$\delta^{\alpha\beta} = 0,\ \alpha \neq \beta;\ = 1,\ \alpha = \beta.$$
(2.1)
$$y_\alpha = \underset{\alpha}{a}^{\nu} x_\nu,\ |\underset{\nu}{a}^{\mu}| \neq 0;\ \sigma^{\alpha\beta} = \xi^{\mu\nu} \underset{\mu}{a}^{\alpha} \underset{\nu}{a}^{\beta}.$$

The new variates y are therefore uncorrelated, each with unit variance. The method of discrimination proposed is that of applying the z-test in that particular one of the hypothetical y variates for which the observed samples give a maximum value of z. Let this be y_λ. For a sample of n observations, we have:

$$\frac{1}{n} \sum_{i=1}^{n} y_{\lambda i} = \bar{y}_\lambda = \bar{x}_\nu a^\nu_\lambda, \text{ where } \bar{x}_\nu = \frac{1}{n} \sum_{i=1}^{n} x_{\nu i};$$
(2.2)
$$\frac{1}{n-1} \sum_{i=1}^{n} (y_{\lambda i} - \bar{y}_\lambda)^2 = \frac{1}{n-1} \sum_{i=1}^{n} \{a^\nu_\lambda (x_{\nu i} - \bar{x}_\nu)\}^2$$
$$= a^\nu_\lambda a^\mu_\nu s_{\mu\nu};$$

where $s_{\mu\nu} = s_{\nu\mu} = \frac{1}{n-1} \sum_{i=1}^{n} x_{\nu i} - \bar{x}_\nu)(x_{\mu i} - \bar{x}_\mu)$.

The tensors $s_{\mu\nu}$, $s'_{\mu\nu}$ are unbiassed estimates of the normalized cofactors of the population tensor $\sigma^{\alpha\beta}$, calculated from n, n'

random multiple observations respectively. Nothing is to be assumed known as to the actual values of $\sigma^{\alpha\beta}$ or of the normalizing transformation coefficients a^{μ}_{λ}.

3. We now take a new vector variable $u^{\alpha} = a^{\alpha}_{\lambda}$, since λ is to be fixed for the problem in hand. The two quadratic forms $s_{\alpha\beta}\, u^{\alpha}u^{\beta}$, $s'_{\alpha\beta}\, u^{\alpha}u^{\beta}$ are positive definite because all principal determinants in any sampling matrix $\|s_{\alpha\beta}\|$ calculated as in (2.2) are Gram determinants, which are positive whenever the p variates are linearly independent. Our special discrimination problem is thus reduced to finding the maximum of $F = s'_{\alpha\beta}u^{\alpha}u^{\beta}/s_{\mu\nu}u^{\mu}u^{\nu}$ or of its reciprocal.

The answer to this is well known. All we need here is the greatest relative characteristic root of the two forms, *i.e.*, of the determinantal equation

(3·1) $\quad \det. \,|s_{\alpha\beta} - \vartheta s'_{\alpha\beta}| = 0,$

or of the reciprocal equation, interchanging s, s'. These roots are all positive. If arranged in descending order of magnitude, they have the minimax property: ϑ^{ν}, $1 < \nu \leqslant p$, is the smallest value assumed by the maximum of F when the u are subjected to $\nu - 1$ independent linear homogeneous restrictions. Thus, all we have to do here is to put $z = \frac{1}{2}|\log\vartheta|$ for the extreme root, using the z-tables of Fisher with degrees of freedom based on the samples alone, as for the single variate. The distribution of the greatest or of any other characteristic root does not enter into the argument, the ratio of the two hypothetically transformed quadratic forms being always that of two sample-variances. What we have obtained is essentially an existence theorem to the effect that the change by means of a suitable linear transformation of co-ordinates (variates) can give a z-value as great as but no greater than the greatest relative characteristic root of the two sampling tensor matrices. So, the z-tables are to be entered with degrees of freedom one less than the number in the samples, in the absence of any other linear restriction on the variates than that incurred in measuring from the sample mean. It might be possible to use the other roots by compounding probabilities, but it must be kept in mind that the minimax property requires that our transformation coefficients, not the variates, be sufficiently unrestricted. For example, our method of deduction cannot be called valid for $p = 1$, $p = 2$, as there are then not enough of the a^{μ}_{ν} left free, for a maximum to exist necessarily, after reducing the population form to a sum of squares. Of course, this is immaterial in view of the fact that $p = 1$ is trivial and $p = 2$ settled by means of a special device.[5] In each of these cases it is true that no *greater* z-discrimination is possible with linear combinations than is indicated by our test.

4. One advantage of the extension is that it holds for any $p > 2$. The ordinary analysis of variance is to be carried out exactly, in view of the fact that any sampling matrix may be broken up into various additive components due to the sources between which one wishes to discriminate. There is the further advantage that in case significant discrimination has been shown, the residual matrix of $\|s_{\mu\nu}\|$ may be used as the fundamental matrix in Hotelling's T^2 in the same way that the residual estimate of variance is used for Student's t after analysis of variance in a single dimension. The disadvantage is that our test would not be so powerful as others in rejecting H_0 when it is false; H_0 here being the null hypothesis that the various sampling tensors are pairwise compatible estimates of the same population tensor.

One method of calculating the extreme root has been given by Fisher (*SMRW* ex. 46.2) who uses divided differences. But equation (3.1) also lends itself to approximation for the greatest root by means of root-squaring. Where the greatest root is not multiple, the rule can be stated immediately, without going into the very simple proof. We define: $\Delta = |s_{\alpha\beta}|$; $\Delta' = |s'_{\alpha\beta}|$; Θ is the sum of the p determinants formed by substituting in rotation a single row in $\|s_{\alpha\beta}\|$ by the corresponding row of $\|s'_{\alpha\beta}\|$, and Θ' the same function interchanging s, s'. Finally, let Δ_m, Δ'_m, Θ_m, Θ'_m be the corresponding functions constructed by squaring (iteration) m times, according to the rule for matrix multiplication, each of the two matrices. Then an approximate value of z for maximal significance is the greater of

$$(4.1) \qquad \frac{1}{2^{m+1}} \log\left(\frac{\Theta_m}{\Delta_m}\right) \text{ or } \frac{1}{2^{m+1}} \log\left(\frac{\Theta'_m}{\Delta'_m}\right).$$

Approximation is quite rapid when the greatest root is isolated. For a multiple root the ratio Θ/Δ must be divided by a factor corresponding to the multiplicity; a similar precaution should also be taken for roots very close together.

5. Still more interesting is the passage to the limit. Suppose we have to deal with silhouttes taken on the profiloscope. One method would be to take some well-defined point such as the ear orifice for the origin, some well-defined line such as that from the origin to the base of the nose as prime vector, and to expand the distance from the origin to the general point of the profile as a Fourier series in terms of the angle from the prime vector. The co-ordinates would then be the Fourier coefficients; if enough were determined to permit the reproduction of any profile to within the original limits of observation, our test or any suitable multivariate test could be applied directly. Yet this is clearly unsatisfactory in that we are using a finite number of co-ordinates in an indefinite number of dimensions without knowing anything of those discarded. The argument that professional anthropometrists do this or worse in using a finite number of characters instead of our harmonic analyser, without proving normality of the distribution, does not suffice. So, we take the other form of the passage to the limit represented by integral equations.

We keep the original quadratic form, extended to infinitely many dimensions; take the co-ordinates as "Fourier" coefficients associated with expansion in some given set of orthonormal functions defined over $0 \leqslant x \leqslant 1$, which is also to be taken hereafter as the range for all undefined integrations. The probability density will again be represented by $c \exp - \phi/2$, with

$$\phi = \int\!\!\int \mathrm{K}(s,t) f(s) f(t)\, ds\, dt\,;\ \bar{f}(s) = \frac{1}{n}\sum_{1}^{n} f_i(s) \tag{5·1}$$

$$\mathrm{S}(s,t) = \frac{1}{n-1}\sum_{1}^{n} \{f_i(s) - \bar{f}(s)\}\{f_i(t) - \bar{f}(t)\}.$$

These now replace (2.1), (2.2) in the function-space, each multiple observation on the variates being taken to define a function $f(x)$ over $0 \leqslant x \leqslant 1$. For significance tests, the reciprocal to $\mathrm{S}(s,t)$ is the best estimate of the population kernel $\mathrm{K}(s,t)$. An alternative simultaneous visualization of the space is, as before, the Hilbert space of the coefficients in the orthogonal-function expansion of $f_i(x)$ Naturally, it is essential to take the population kernel $\mathrm{K}(s,t)$ as positive, semi-definite or definite; its characteristic functions form the most convenient orthogonal functions to use for theoretical purposes, which amounts to using a quadratic form with diagonal matrix. If the characteristic orthonormal functions do not form a closed set, as many more are to be adjoined as are necessary for closure, taking the additional co-ordinates associated with these extra functions to constitute the orthocomplement to the function manifold of $\mathrm{K}(s,t)$. In probability integrations, these extra co-ordinates will be undetermined, hence to be integrated over the whole of the orthocomplement. This allows all kernels to be considered in a proper function-space, even the degenerate kernels that actually include the ordinary p-variate normal distribution; conversely, the p-variate case may be considered as associated with a degenerate $\mathrm{K}(s,t)$, by ascribing one function of an arbitrary orthonormal set to each co-ordinate as coefficient. For limits of integration, we use the convenient as well as fashionable terminology of lattice theory, taking $f \smile g$, $f \frown g$ respectively as the functions whose "Fourier" coefficients are the greater and the lesser of the corresponding coefficients in the expansions of f and g. Thus, the integration can extend from $f \frown g$ to $f \smile g$, and over the whole of the orthocomplement whenever integration "between" two function-limits f, g is to be performed.

6. The trouble with all this is that it has only an appearance of verisimilitude. In a space of infinitely many dimensions, we have as yet failed to define the volume element. If we take the multiple integral over infinitely many dimensions as evaluated by successive iterated integrals in the usual manner, it will be seen that any consistent evaluation making the total probability unity leads in general to zero probability in integrating over any proper sub-manifold of the whole space. One must go much deeper than the intuitive methods of 5. It is seen that if we merely take limits increasing the number of dimensions, the "volume" of a hypercube is 0, 1, or ∞; of a hypersphere zero, as the n-dimensional

sphere has the volume $2\pi^{\frac{n}{2}}r^n/n\,\Gamma(n/2) \rightarrow 0$ as $n \rightarrow \infty$.

This difficulty is surmounted under the hypotheses that the abstract space under consideration has a distance relationship obeying the usual postulates; is separable, locally compact, with a congruence relation. The two middle ones have to remain assumptions, distance r being defined by $r^2=\phi(f-g)$, for any two elements f, g. The space has to be restricted to elements for which $K(s,t)$ is a positive definite kernel. Congruence of two regions may be taken as transformability of one region into the other by some member of a suitably restricted (linear) transformation group, preserving $\phi(f-g)$ and transforming the entire manifold into the entire manifold. Then a Haar measure[7] and a Lebesgue-Stieltjes integral exist. Unrestricted Hilbert space is not locally compact because no infinite sequence of orthogonal functions can converge in L^2.

It follows that all classical results can be stated and proved again in general abstract spaces, though it is better for our purpose to take kernels of the second (Fredholm) kind for some theorems, which means only the addition of a term $\int f^2 ds$ to the ϕ of (5.1). We may then state such results as: *The sum of two normally distributed variates is also normally distributed with mean the sum of the two means and kernel whose (formal) reciprocal is the sum of the two (formal) reciprocals of the given kernels.*

Many fundamental procedures and distributions may be generalized to this space, including some of the more powerful tests considered by P. L. Hsu.[6] Not only can the Hotelling-Fisher formulæ[2] be derived from a degenerate population kernel of p degrees of freedom, but a space of sufficiently large (or infinite) number of dimensions would lead to corresponding formulæ with $p=n$, the degrees of freedom within groups. It is clear, however, that the nature of the fundamental abstract space associated with a given population will not be revealed in general by means of the sample taken by a practising statistician; here, I regret my inability to demonstrate with a practical example, for which there is data enough but no access to the necessary machines: ordinary or cinema integraph, differential analyser, etc. In any case, it is clear that a test which applies independently of dimentionality,[8] without new tables, becomes of importance whether or not more efficient and powerful tests could be devised for the particular unknown population in question. This test is the analogue of (3.1); taking limits, we state it as the problem of locating the extreme characteristic root of $\int \{S[s,t] - \vartheta S'[s,t]\} f dt = 0$. By noting that the sample kernels S, S' are degenerate, this can be reduced to a set of linear equations in a finite number of unknowns, whence the existence of a finite number of positive determinate roots follows at once. It is proposed that the extreme root be used as before for the z-tests; the estimating kernels may still be broken up into additive components, permitting analysis of variance. It would, of course, be convenient to have the distribution of certain sampling functions, as for example of $\int\int S^{-1}S'\,ds dt$, where S^{-1} is the reciprocal to $S(s,t)$.

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[1] H. Hotelling, "The Generalization of Student's Ratio," *Annals of Mathematical Statistics*, 1931, **2**, 360–78.

[2] R. A. Fisher, *Statistical Methods for Research Workers*, 1938, 7th ed., 294–98.

[3] P. C. Mahalanobis, *Proc. Nat. Inst. Sci. India*, 1936, **2**, 49–55; R. C. Bose., *Sankhyā*, 1936, **2**, 143–54, 379–84; S. N. Roy, *Ibid.*, 385–96.

[4] S S. Wilks, "Certain Generalizations in the Analysis of Variance," *Biometrika*, 1932, **24**, 471–94.

[5] D. D. Kosambi, "A Bivariate Extension of Fisher's z-Test," *Cur. Sci.*, 1941, **10**, 191–92.

[6] P. L. Hsu, *Biometrika*, 1940, **31**, 221–37; *Annals of Mathematical Statistics*, 1939, **9**, 231–43; *J. London Math. Soc.*, **16**, 1941, 183–94.

[7] Stefan Banach, in S. Saks, *Théorie de l'Intégrale*, 1933, 204–72.

[8] If the Haar volume of the sphere $\phi(\gamma) \leqslant r^2$ is cr^k, we have the usual k-dimensional space or its equivalent. But we also get fractional dimensionality when k is non-integral. So, the degenerate kernel need not necessarily lead to the ordinary p-dimensional case. For the existence and construction of point-sets with fractional dimension, see F. Hansdorff, *Math. Annalen*, 1919, **79**, 157–79.

A CHEAP ANTI-MALARIAL DRUG IN INDIA

THE history of cinchona cultivation in the British Empire constitutes a tragedy of mismanagement. During the closing years of the last century, India and Ceylon led the world to an extent that over-production occurred and the inevitable crash brought about the extinction of the cinchona industry in the British Empire; but owing to climatic advantages and more scientifically regulated control, the Dutch industry in Java survived. To-day that island has a virtual world monopoly, while India produces 70,000 pounds a year against her real requirements of at least 1,000,000 pounds. Again, as in 1914, India is seriously alarmed at the prospect of a quinine famine in the face of the threat of war. The adoption of some intelligent forward policy in this direction is an urgent matter, but even if cinchona cultivation were immediately extended, appreciable results would not be obtained for at least ten years. With the awakening of interest in the pharmaceutical industry in India, a demand has arisen for the revival of cinchona cultivation. It is not suggested that Java should be ousted from her present position of world monopoly, but that at least India should cater for her own needs. The object of supplying a cheap anti-malarial drug for the people should be kept clearly in mind. Sir R. N. Chopra's recommendation that the Cinchona Department should cultivate on a large enough scale that species of cinchona best suited to the Indian climate has not been acted upon. The main obstacle to the problem of distribution to the needy is the high price of quinine fixed by the Java monopoly.

Even if cinchona cultivation were extended in India, the price would remain relatively high, but it is pointed out in a recent issue of the *Indian Medical Gazette* that a preparation of mixed cinchona alkaloids of the "totaquina" standard could be produced at a cost of one-seventh that of quinine. The "totaquina" standard rivals in efficiency that of pure quinine, and wherever it has been tried out on an extensive scale this has been confirmed, while there are many who believe that the mixed alkaloids are even more efficacious than quinine in certain forms of malaria. This standard originated with the Malaria Commission of the League of Nations as being an efficient anti-malaria drug that could be prepared from the hardier cinchona plants in the form of crystallisable alkaloids mixed in the proportion in which they occur naturally in cinchona bark. It is not generally realised that the preparation known as "cinchona febrifuge" contains the mixed alkaloids remaining after the removal of the valuable quinine, and its universal use in malaria is therefore to be depricated, but the British Pharmacopœia standard for totaquina demands that it shall contain at least 70 per cent. of crystallisable alkaloids, of which at least 15 per cent. shall be quinine. The essence of the whole matter would appear to be that, owing to the failure to realize the urgency and magnitude of the problem, generations of doctors and the public have been educated to believe that only one alkaloid—quinine—is of any value in the treatment of malaria, when, on the contrary, it is probable that powdered cinchona bark gives every bit as good a result and could be manufactured at a price at which universal distribution to the malaria-stricken millions of India would become a possibility.

In 1937, on the recommendation of the Indian Research Fund Association, the Government of India appointed an officer to determine what areas in India are best suited to cinchona cultivation, and what would be the cost of production in such areas. In this investigation the land considered suitable for *Cinchona ledgeriana* has been chosen on the grounds that it yields the maximum quantities of quinine. The contention is that the Government in India should extend their present plantations, still growing the high-quinine-yielding *C. ledgeriana* in suitable areas, grow *C. robusta* and other hardier species in other areas, and in their factories manufacture a large preponderance of totaquina and smaller amounts of pure alkaloids. No real progress can be made, it is argued with some force, until the commercial has been made subservient to the medical point of view.

—From the *British Medical Journal*.

LETTERS TO THE EDITOR

APPLICATION OF X-RAY METHODS TO THE CONFIRMATION OF THE IDENTITY OF ORGANIC COMPOUNDS

The identity of organic compounds is usually shown by the undepressed melting point of mixtures of substances and of mixtures of their similar derivatives. We have used X-ray methods of crystal structure analysis for the confirmation of the identity of 2 : 4 dibromo-6-nitro resorcinol-3-methylether obtained by one of us (M. S.) by bromination and nitration respectively of 5-nitro-2-hydroxy-4-methoxy-benzaldehyde and 3 : 5 dibromo-2-hydroxy-4-methoxy-benzaldehyde. In both cases, on recrystallisation, fibrous acicular crystals were obtained. They were both found to be orthorhombic with one of the crystallographic axes coincident with the length of the needles. Rotation photographs of crystals obtained by both methods were taken, the length of the acicular crystals being parallel to the axis of rotation, using copper K_α radiation and a cylindrical camera of radius 32·03 mm. The identity period obtained from these photographs are 4·13 ± 0·02 Å for the product obtained by nitration and 4·11 ± 0·02 Å for the other. The photographs were also identical in all respects, all the corresponding spots coinciding exactly on superposition of the photographs. Accurate measurements of the co-ordinates of the more prominent spots made on one photograph were found to be in agreement with those on the other within the limits of errors of measurement. These results confirm the identity of the two products obtained as indicated above.

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April 14, 1942.

A NEW BAND-SYSTEM OF BORON MONOXIDE

A preliminary note on some continuous diffuse bands (fluctuation bands) obtained in the spark between glass electrodes reported the presence of discrete bands among some of the fluctuation bands.[1] An analysis of these discrete

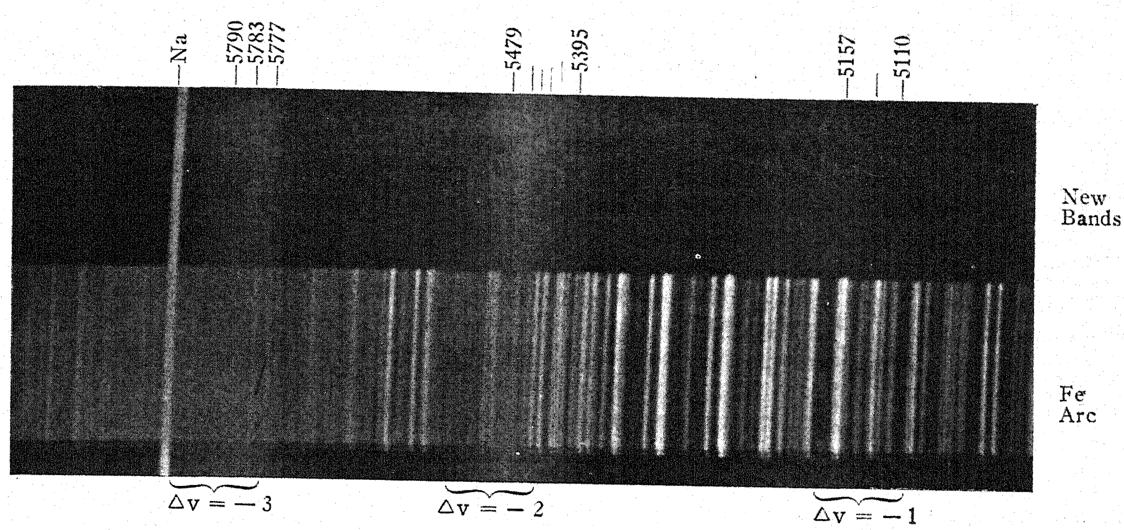

FIG. 1

bands has now been done, which shows that they form a new electronic system in the BO molecule. As a result of this analysis it has been further found cut that the diffuse fluctuation bands are not due to SiO_2 but are the well-known so-called boric oxide bands.[2]

It will be seen from Fig. 1, which is an enlarged reproduction of a spectrogram of the radiation from a Bunsen burner fed with boric acid, taken on a constant deviation glass spectrograph, that there are at least three groups of bands which form three sequences. These when arranged in the v'v'' array yield the following $\Delta v''$ values given in Table I, where the $\Delta v'$ values[3] for the β-bands of $B^{11}O$ are also included.

TABLE 1

Vibrational Term Differences

Levels	0—1	1—2	2—3	3—4	4—5	5—6	6—7
Initial of β bands of[3] $B^{11}O$ = $\Delta v'$	1259	1237·8	1217·4	1198·6	1179·1	1160·7	—
Final of the new system = $\Delta v''$	—	—	1225	1206	1174	1162	1142

The agreement between the two sets of values indicates first, that the electronic levels of which these are the vibrational term differences are identically the same and secondly, that the first term difference observed in the new bands is already the one between the second and the third vibrational levels of BO in this common electronic state. On this basis the following expression is derived for the wave-numbers of the band heads of the new system:—

$$\nu_{\text{head}} = 21005\cdot6 + (1200\ v' - 15\cdot4\ v'^2) - (1266\ v'' - 10\ v''^2).$$

The O,O band has not been observed but the v' numbering also seems certain. The expression further shows that the final vibrational function $(1266\ v - 10\ v^2)$ of the new system is, within the limits of allowable error, the same as the initial of the β bands of $B^{11}O$ $(1268\cdot8\ v - 9\cdot98\ v^2)$. The new electronic level is thus located at $\nu = 63870\cdot8$ cm.$^{-1}$ (21005·6 *plus* 42865·2 the origin of β bands) or 7·9 e.v.

These bands are not usually obtained in the method of production (active nitrogen *plus* BCl_3 vapour) employed for the development of the α, β and combination band-systems of BO. Also the latter band-systems are not developed, except for possible traces of some of them, either in the boric acid flame or the spark discharge. The new bands, however, always

accompany the diffuse fluctuation bands, the so-called boric oxide bands, which also appear to be due to BO molecule. These and other considerations pertaining to the diffuse bands indicate that the initial state involved in the new band-system is a Σ, possibly a quartet Σ level, arising out of B ($2s^2 2p^2, {}^4P$) and O ($2s^2 2p^4, {}^1D$). There is further reason to think that probably such a state of BO is directly reached when the molecule is obtained from B_2O_3.

It is remarkable, however, that the spectrograms which show these diffuse fluctuation bands in the glass spark do not show any trace of the resonance lines of boron. It is evident that for detection of boron in the form of B_2O_3 or boric acid, these bands are much more sensitive than the *raies ultimes* of boron. The glass used was supposed not to contain any chemically traceable boron.

Details regarding these and other points will be published elsewhere. I am grateful to Prof. R. K. Asundi for helpful discussion and continued interest in the work.

NAND LAL SINGH.

B/1 Quarters,
Benares Hindu University,
June 12, 1942.

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[1] *Proc. Ind. Sci. Congress, Benares*, 1941, 29, Part III.
[2] *Handbuch der Spectroscopie*, 1910, Band V, 138. (Kayser).
[3] *Phys. Rev.*, 1925, **25**, 59.

A NOTE ON THE ISOLATION OF THREE NEW BITTER PRINCIPLES FROM THE NIM OIL

THE active constituents of the Nim oil have interested a number of workers since Chatterji and Sen[1] reported the isolation of the so-called 'margosic acid' from it, in 1919. The investigations on this problem have, however, led to findings of a very conflicting character. Thus the margosic acid, which was considered to be the active principle of Nim oil was later shown to be mainly a mixture of fatty acids.[2] In 1923, Watson and co-workers,[3] isolated from the soap lye of the oil a sulphur-free crystalline bitter acid 'margoso-picrin', in a yield which works out to 0·012 to 0·017 per cent. on the weight of the oil and amorphous bitter acids in a yield of ca. 0·15 to 0·24 per cent. Sen and Banerji[4] noted the isolation of a sulphur containing acidic bitter principle from the aqueous extracts of the oil (yield not mentioned). More recently Quadrat-i-khuda and co-workers[5] communicated the isolation of the sulphur-containing essential oil and an amorphous, water-soluble bitter principle from the aqueous extracts of the oil, after previously subjecting it for long periods to steam distillation for removal of the steam voltaic products.

The methods employed by Watson and co-workers as well as by Q. Khuda and co-workers for the isolation of the active principle, appear to be of too drastic a character to ensure the isolation of the bitter principle in its native condition. In view of the growing importance of the Nim oil as a commercial product and the long established uses of Nim in the indigenous systems of medicine as a bitter tonic, an anti-malarial and anthelmintic, and as a cure for syphilitic conditions and a variety of skin diseases, a re-investigation of the active principle of the oil was considered of interest, as part of a general scheme of research for establishing its industrial uses.

Working on a so far unexplored plan of exclusively mechanical separation of the various constituents of the Nim oil, the following well-defined bitter constituents have been isolated from it, the total bitter constituents being obtained in an industrially workable yield of ca. 1·2 per cent. as against 0·24 per cent. reported by Watson and co-workers:

(1) A sulphur-free, neutral, water-insoluble, colourless crystalline product melting at 205° C. and provisionally named as 'NIMBIN'. Yield—0·1 per cent. on the weight of the oil.

(2) A bitter principle of similar characteristics as 'NIMBIN' melting at 192° C., which has been provisionally named as 'NIMBININ'. Yield—0·01 per cent. on the weight of the oil.

(3) A cream-coloured, water-insoluble, granular powder of neutral character, provisionally named as 'NIMBIDIN'. M.p. 90-100° C. Yield—1·1 per cent. on the weight of the oil.

In the process of isolation of the bitter principles, a treacly sulphur-containing product has also been obtained and is being studied further.

The bitter constituents mentioned above, are quite distinct from the acidic or water-soluble bitters reported by earlier authors, as they are all of them neutral in character and insoluble in water. Owing to their insolubility in water as well as in the alkaline saliva they are nearly tasteless in powder form. Their colloidal solutions in alcohol-water, however, are intensely bitter, 'NIMBIDIN' being perceptibly bitter in dilutions upto 1 in 100,000 with the characteristic bitterness of fresh Nim twigs. On mild hydrolysis 'nimbidin' and 'nimbin' yield acidic and partly water-soluble bitters. The combustion value indicates an empirical composition of $C_7H_{10}O_2$ for 'nimbin'. The main bitter principle of the Nim oil, 'nimbidin', which is amorphous and for which, therefore, only a limited degree of uniformity can be claimed, appears to contain sulphur not as an impurity but as a part of its constitution. This point, which is being further investigated, is of exceptional interest in view of the fact, that all the bitter principles of Nim oil reported by earlier authors have been noted to be free from sulphur, with the exception of the sulphur-containing bitter acid reported by Sen and Banerji.[4]

The method employed for the isolation of the bitter products does not involve the initial saponification of the oil and is based on the difference in the solubilities of its various constituents in dilute alcohol and other non-miscible organic solvents like ether, petrol-ether and ethyl acetate. Apart from the fact that such a method ensures the isolation of the constituents in the form in which they are present in the oil, it has the further advantage of yielding a comparatively purified oil which could be used in the soap manufacture or for any other industrial purposes.

From the preliminary bacteriological tests, it appears that nimbidin is the main active constituent of the Nim oil. A systematic chemical and pharmacological study of the isolated products is now being carried out under a definite scheme of the Drugs Committee of the Council of Scientific and Industrial Research, for the investigation of Nim oil with reference to its active constituents and its general industrial utilisation.

S. Siddiqui.

Laboratories of the Director,
Scientific and Industrial Research,
University Buildings,
Delhi,
June 10, 1942.

1 *Ind. Med. Gaz.*, 1919, **54**, 174.
2 A. Roy and S. Dutt, *Jour. Soc. Chem. Indus.*, 1929, 333T.
3 —, *Ibid.*, 1923, **42**, 387T.
4 *Jour. Ind. Chem. Soc.*, 1931, 773.
5 *Ibid.*, 1940, 189.

CHEMICAL TEST FOR DETECTION OF ARGEMONE OIL

In view of the importance of argemone oil in the ætiology of epidemic dropsy as worked out by Lal *et al.*[1] with whom the author was also associated, the recent work on a sensitive chemical test with ferric chloride by Sarkar[2] for detection of argemone oil alone or in solution with mustard oil up to the concentration of 0·75 per cent. is of interest.

The use of $FeCl_3$ as a reagent for characteristic colour reaction with some alkaloids, *e.g.*, morphine, mixed ipecacuanha alkaloids, colchicine, etc.,[3] is well known. The precipitate obtained in the $FeCl_3$ test of argemone oil has been found by the author to be due to a new alkaloid present in argemone oil and which has been isolated by Mukherji, Lal and Mathur[4] by saponification (W.C.S.) and hydrochloric acid extraction (C.F.B.) of it. Some other common alkaloidal reagents like Mayer's and Wagner's have also been tried with satisfactory results.

The sensitivity of the $FeCl_3$ test as suggested by Sarkar is, however, affected for two reasons, namely, (*a*) an emulsion of acid and oil resembling a precipitate is already formed at the acid-oil interface before addition of $FeCl_3$ solution, and (*b*) the oil-layer absorbs some amount of precipitate obtained by the addition of $FeCl_3$. The following modification has been found to have improved the test.

Instead of adding $FeCl_3$ solution straight to the mixture of oil and acid, the acid layer is first separated by centrifugation. To 1 c.c. of this acid extract which should be absolutely free from any oil globules 4 to 5 drops of $FeCl_3$ solution (10 per cent.) is added. The rest of the test is practically the same as carried out by Sarkar except that the addition of ethyl alcohol is omitted as it has been found to be of no use. After the test is thus modified it can detect argemone oil to a concentration of 0·2 per cent. or even less.

The author considers that from the practical and Public Health points of view HNO_3 test is quite satisfactory and $FeCl_3$ test may also be adopted on qualitative basis. But before the latter is finally accepted as a specific test for argemone oil as claimed by Sarkar more elaborate work would be necessary.

My best thanks are due to Lt.-Col. S. S. Sokhey, Director, for his kind interest in this work.

S. P. MUKHERJI.

Haffkine Institute,
Bombay,
June 22, 1942.

1 Lal, R. B., Mukherji, S. P., Roy, S. C., and Sankaran, G., *Ind. Jour. Med. Res.*, 1939, **27**, 207.
Lal, R. B., Mukherji, S. P., Das Gupta, A. C., and Chatterji, S. R., *Ibid.*, 1940, **28**, 163.
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EGGS OF THE GOAT WARBLE-FLY (*HYPODERMA CROSSII* PATTON)

CROSS (cited by Patton, 1922) was the earliest to record the occurrence of the goat warble-fly in India. He collected large numbers of larvæ and adults of this species from the Salt Range area of the Punjab. Patton, in 1922, described this species and named it after Cross. Soni (1939, 1940) published a detailed account of the morphology of the young and full-grown larvæ and also observations on the bionomics of the same pest.

India produces one-third of the total production of goat-skins in the world and, in view of the great damage caused to this commodity by the goat warble-fly, it is essential that more should be known about its life-history and bionomics. A perusal of the available literature on the subject shows that the eggs of the species of *Hypoderma* have not been encountered. Patton (1922) observes: "It is just possible that the female *Hypoderma crossii* lays her eggs directly on the long hairs on the sides of the goats, and that the larvæ enter the skin below and remain there, and that there is no migration as in the case of *H. bovis* and *H. lineatum*. Captain Cross tells me he

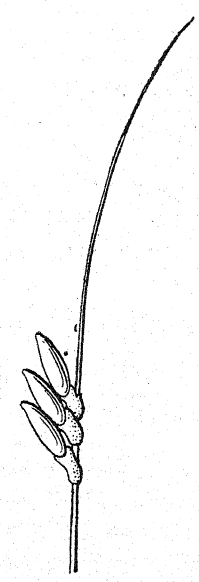

FIG. 1
Eggs of *Hypoderma crossii* ×11·25

has never found any eggs on the hairs of the legs of the goats he has examined."

During my recent survey of Jhelum district in the Punjab and Kulu valley I came across the eggs of *H. crossii* attached to the hair on the back of the goats of the 'Barbary' breed. The eggs were invariably found on the underside of the hair where they were protected from direct contact with environmental factors. Like *H. lineatum* and unlike *H. bovis* the eggs are attached in rows to a single hair, each egg being at an angle of about 45° to the axis of the hair. The egg is of a dull yellowish-white colour and the surface smooth and shining. It is ovoid in shape and slightly broader at the base than at the tip. The average length of the egg is 0·75 mm. and the average breadth at its greatest thickness 0·2 mm. The tip of the egg has a slight transverse ridge, along which the egg splits during hatching. The clasp with which the egg is attached to the hair is oval in outline. Its most characteristic difference from the egg of *H. lineatum* and *H. bovis* is the absence of a petiole or stalk between the clasp and the egg proper (Fig. 1).

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Imperial Veterinary Research Institute,
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June 9, 1942.

1 Patton, W. S., *Ind. J. Med. Res.*, 1922, **10,** 573.
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ON THE PRESSOR EFFECT OF ADRENALINE POWDER

The rotation of a sample of adrenaline powder is believed to indicate the purity of this compound; but many samples showing lower rotation with the sodium line are being found on physiological assay on decapitated cats to correspond to almost 100 per cent. of the powder (sample No. 1) which has satisfied all the purity tests as described in the British Pharmacopœia. Again some samples of natural origin though not so pure from B.P. tests, offer better response so far as the rise of blood pressure in animals are concerned. A particular synthetic product (sample No. 4 in the table) although rotates the plane of polarisation of light to a considerable degree was found to be much inferior in biological strength.

Table I

Sample	Origin	Melting point	Specific rotation B.P. Method	Assay	
				Chemical[1]	Biological
1	Synthetic	210° C.	— 52·2°	100%	100%
2	Do.	207-208	— 48·3	99	100
3	Do.	207	— 46·8	101	100
4	Do.	207	— 49	95·5	88
5	Do.	201	— 49·5	101·0	100
6	Natural	—	—	—	106
7	Do.	199-201	— 43	98	111
8	Do.	Indifferent	Too coloured solution	75	110

All these tend to raise two questions—one is that a powder equivalent in biological potency to any standard adrenaline may be of inferior quality from purity tests. This suggests that a more elaborate and detailed criteria should preferably be established for the evaluation of the properties of an adrenaline powder that be suitable for preparing Liquor Adrenalinæ Hydrochloride. The other point is whether a powder from natural sources as commercially available contain substance or substances (even in trace) that may produce a synergistic effect on the sympathomimetic action of the drug. Work in this Laboratory is in progress to find out whether the fractions during the course of extraction of the active principle from suprarenal glands exert any synergic effect on the pressor activity of the final purified powder.

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S. K. Ganguli.
Bengal Immunity Research Laboratory,
Calcutta,
June 19, 1942.

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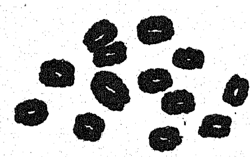
CHROMOSOME NUMBER IN *TINOSPORA*

WHILE examining the pollen mother-cells of *Tinospora cordifolia* Miers, in connection with certain studies on the chromosomes of diœcious plants, it was observed that the haploid number in this plant is $n = 13$, and not $n = 12$ as previously reported by Joshi and Rao.[1] This count was made by examining pollen mother-cells in acetocarmine and was confirmed by studying a very large number of flower buds from two male plants, while the observations of the above authors were made from fixed and sectioned material. If their observation is correct, it shows the presence of aneuploidy in this species. However, one might expect $n = 13$ as the more likely number in *Tinospora* as the related genus *Menispermum* has $n = 26$ Lindsay[2]). In that case the statement of



Chromosomes of *Tinospora cordifolia* at metaphase of first meiotic division in pollen mother-cell. × 2,000. Note one large pair as observed by Joshi and Rao also.

Joshi and Rao regarding the presence of a progressive difference in the chromosome numbers of genera belonging to the Menispermaceæ, beginning with $n = 12$ in *Tinospora* and passing on through $n = 19$ in *Cocculus* to $n = 26$ in *Menispermum* is without any suggestive relation to Anderson's[3] speculation regarding the origin of the angiosperms, by wide crosses between some of the simpler members of the seven chromosomed and twelve chromosomed gymnosperms, followed by doubling of the chromosomes in the hybrid. Recent studies made in this laboratory by Kumar and Ranadive,[4] on the genus *Anona,* allied to the Menispermaceæ show that $n = 7$ is the haploid number for four species investigated by them. Further, it will be seen that the haploid numbers 12, as well as 7 and multiples of 7 are very frequently met with in Ranunculaceous genera (Gaiser[5]). In *Magnolia denudata,* Andrews[6] has noted $n = 48$, a multiple of 12, and unrelated to $n = 19$, which is found in some other genera of the Magnoliales. If the basic chromosome numbers of primitive dicotyledonous families would give any clue to the origin of the angiosperms, the cytologist can at present go no further than ask whether the angiosperms may not have had a common origin with the gymnosperms in some seven-chromosomed or twelve-chromosomed ancestral type (see Kumar and Ranadive).[4]

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College of Agriculture,
Poona,
June 11, 1942.

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PUCCINIA DROOGENSIS BUTLER ON *BERBERIS ARISTATA* D.C.

IN some collections of fungi made at Kodaikanal by the writer in 1940 was a rust on *Berberis aristata* D.C. (*B. tinctora*), which agreed with *Puccinia droogensis* recorded by Butler (1905) in the Nilgiri Hills, S. India. The telia were present in abundance, and associated with them were uredial and æcial pustules. Microscopic examination of the sections of the infected leaves revealed that pycnia æcia and uredia develop from the same infected patch. In another collection made in February 1942, pycnia and æcia were also observed in large numbers along with young uredia. It is manifest that all the spore forms occur on the same host, this being the first report on the occurrence of pycnial and æcial stages for the rust.

Pycnia are distributed on the leaves on slightly swollen patches. The infection spot is pinkish-red in early stages. Pycnia are subepidermal (Fig. 1), amphigenous, minute,

orange-yellow with well-developed ostiolar filaments. They measure up to $120 \times 136\,\mu$. Æcia are cupulate (Fig. 5) with incurved margins, and erumpent. Æciospores are yellow, polyhydral, binucleate (Fig. 2), measuring

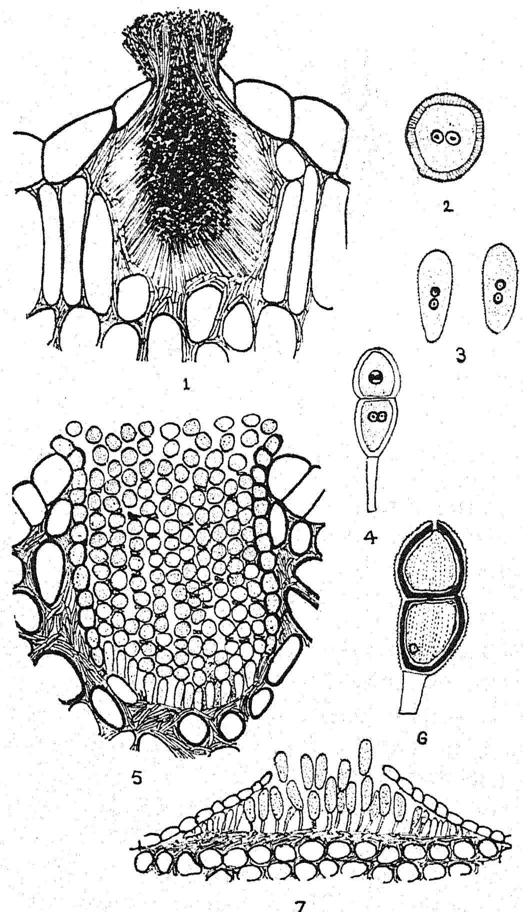

Fig. 1. Subepidermal pycnium $\times$ 426·6. Fig. 2. Binucleate æciospore $\times$533·33. Fig. 3. Urediospores showing verrucose exospore $\times$ 426·6. Fig. 4. Young teliospore $\times$533·33. Fig. 5. Section through an æcium showing chains of spores $\times$266·33. Fig. 6. Mature teliospore showing three wall layers $\times$533·33. Fig. 7. Section through an uredium $\times$ 106·6.

$18\text{-}22 \times 16{\cdot}4\text{-}18\,\mu$. The germ pores are indistinct and become apparent only at the time of germination. The peridial cells are larger in size, slightly angular, minutely verrucose, measuring $21{\cdot}8\text{-}27 \times 16{\cdot}3\text{-}20\,\mu$.

Uredial infections do not cause any hypertrophy. Uredia are subepidermal (Fig. 7), amphigenous, yellow, minute, aparaphysate and pulverulent. The urediospores are stipitate, clavate or ellipsoid (Fig. 3) and minutely verrucose, measuring $16\text{-}20 \times 27\text{-}41\,\mu$.

Telia are purplish-brown and amphigenous. The sori are erumpent and confluent in concentric rings. It was noted that the telia are formed within old uredia. Teliospores are two-celled (Fig. 6), stipitate, rounded at both ends, and constricted in the region of septa. Young teliospores are binucleate (Fig. 4) and the two nuclei fuse forming a syncaryon. There are three wall layers, the outermost being cuticular and covered with minute tubercles. These are arranged in longitudinal rows giving the spores a striate appearance. There is a single distinct germ pore in each cell of the spore, and this feature, in spite of the fact that there are three wall layers, clearly points out that the rust is *Puccinia*, and separates it from *Cumminsiella* recorded on other species of *Berberis* (Arthur, 1933). The teliospores measure $30\text{-}44 \times 19\text{-}23\,\mu$, and germinate within three days when placed in moist chamber.

The rust is an autoecious eu-form. *Æcidium montanum* Butler which is recorded on *Berberis Lycium* Royle, *B. Coriaria* Royle, and *B. aristata* D.C., causes witches brooms and extensive deformations of the host tissue. The æcia of *Puccinia droogensis* on the other hand do not cause such malformation, the sori being distributed on slightly swollen patches. Further the æciospores of *Æcidium montanum* measure $17\text{-}35 \times 17\text{-}29\,\mu$ (average $19 \times 23\,\mu$), but those of *Puccinia droogensis* $18\text{-}22 \times 16{\cdot}4\text{-}18\,\mu$. These characters differentiate *Æcidium montanum* from the æcial stage of *Puccinia droogensis*.

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June 5, 1942.

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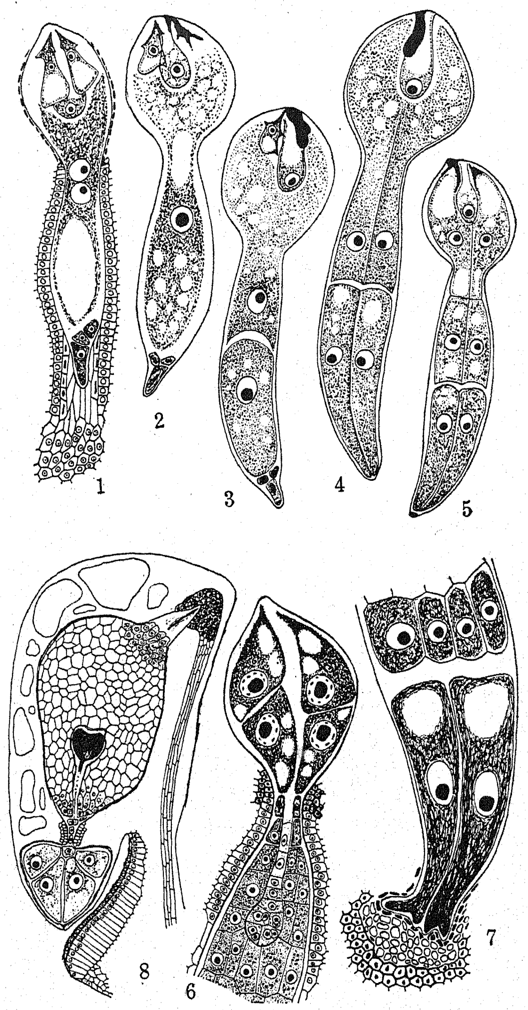
[2] Butler, E. J., *Ind. Forester*, **1905**, **31**, 670.

ENDOSPERM FORMATION IN *ANISOMELES* SP.

The present study embodies a short account of the origin and development of endosperm in *Anisomeles malabarica* and *A. indica*. Further work on the embryological and other morphological aspects of these plants is in progress.

The embryo-sac in both species exhibits two distinct regions, *viz.*, a broadened micropylar part containing the egg apparatus and a narrow chalazal part invested by a jacket of integumental nutritive cells. The region between these two parts is constricted, where, the polar nuclei fuse to form the secondary nucleus (Fig. 1).

After fertilization, the primary endosperm nucleus moves to the middle of the chalazal end of the embryo-sac and divides by a transverse wall to form two chambers (Figs. 2 and 3). The nuclei in both the upper and lower chambers now divide by longitudinal walls (Fig. 4). The lower two cells do not divide further but assume the function of an haustorium, and begin to penetrate in the direction of the vascular trace. The two upper cells, on the contrary, divide once more by transverse walls resulting in four cells (Fig. 5). Thus three primary tiers of two cells each are formed in the embryo-sac. The uppermost cells divide once more by transverse walls into four cells which enlarge and organise micropylar haustorial apparatus (Fig. 6). The middle cells, which lie between the two-celled chalazal and four-celled micropylar haustoria, divide further by vertical and transverse walls and give rise to a massive central endosperm tissue in which the embryo becomes embedded ultimately. The nuclei in the micropylar haustorial cells enlarge considerably and show conspicuous nucleoli (Figs. 6 and 7). The chalazal haustorium begins to function earlier than the micropylar haustorium and disorganises after absorbing the nutrition transported by the vascular trace. The micropylar haustorium takes part in the absorption of the disintegrating integumental tissue and continues its function until the embryo has reached considerable size. The passage between the micropylar haustorium and the central endosperm



FIGS. 1-8. *Anisomeles indica*

Fig. 1. Eight-nucleate embryo-sac × 800. Fig. 2. Post-fertilisation embryo-sac showing the prominent primary endosperm nucleus × 800. Fig. 3. Embryo-sac divided into micropylar and chalazal chambers × 800. Fig. 4. Formation of longitudinal walls in the upper and lower chambers of the embryo-sac × 800. Fig. 5. Embryo-sac showing the three primary pairs of endosperm cells ×560. Fig. 6. Micropylar haustorium and embryo × 800. Fig. 7. Chalazal haustorium at an advanced stage × 800. Fig. 8. *A. malabarica*.

A longitudinal section of the ovule showing the micropylar haustorium, endosperm tissue, lacunæ in the integument and the obturator × 160.

tissue is constricted into a narrow isthmus through which nutritive material is transported to the growing embryo by means of conducting cells which are transformed endosperm cells (Fig. 8).

The development of the central endosperm tissue takes place simultaneously with the growth of the haustoria and finally it attains a large size by destroying the surrounding ovular tissue (Fig. 8). In advanced stages, a section of the ovule reveals a large mass of endosperm enclosing the growing embryo and the remnants of the haustoria, both micropylar and chalazal, still persisting.

The pro-embryo descends into the central endosperm tissue by means of its long suspensor and the embryo is initiated in its terminal cell by a vertical wall. The embryo enlarges to such an extent as to displace the endosperm tissue almost completely.

The ovule in both species is characterised by the presence of a massive obturator over the micropyle. The sub-epidermal cells of the obturator become elongated as the development of the embryo progresses (Fig. 8).

In conclusion, I wish to acknowledge my indebtedness to Dr. L. Narayan Rao, Professor of Botany, for his kind guidance.

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June 6, 1942.

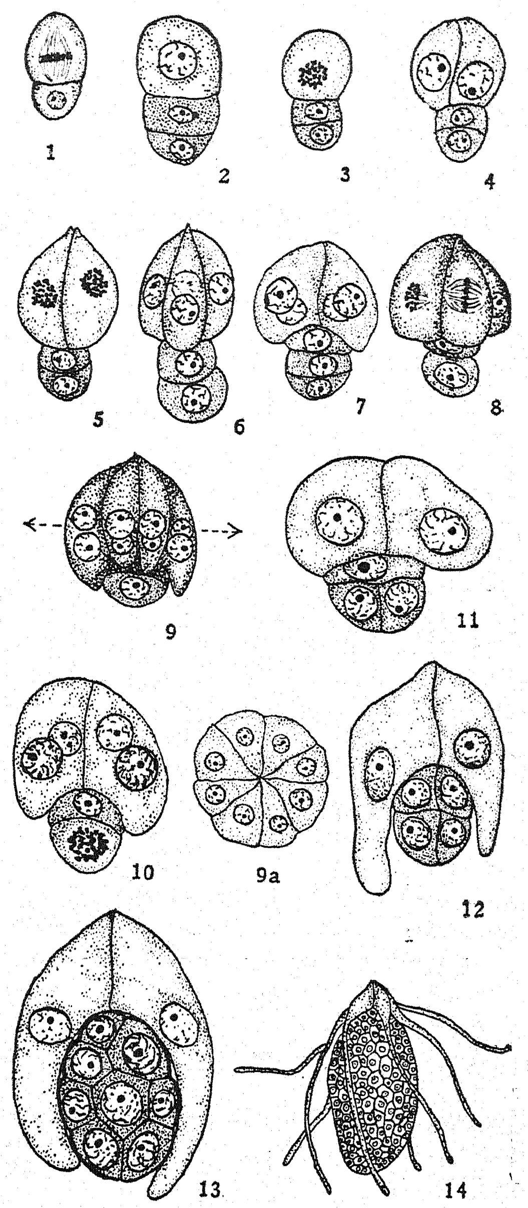
MORPHOLOGICAL STUDIES IN THREE SPECIES OF *VANDA*

ORCHIDS present much morphological variations especially during the post-fertilization development. This note is confined to observations on the following species of *Vanda*:—

V. parviflora Lindl.
V. spathulata Spreng.
V. Roxburghii Br.

Development of the embryo was traced in greater detail in *V. parviflora*, but the course of development appears to be similar in all the three species.

The development of the embryo-sac is of the



Figs. 1 to 13 × 450; Fig. 14 × 80.

Normal-Type, sometimes presenting a tendency towards a reduction in the number of nuclei at the antipodal end of the embryo-sac. Double fertilisation occurs. The primary endosperm

nucleus degenerates sometimes even before a complete fusion of all the three nuclei.

The zygote divides by a transverse wall. The micropylar cell divides first (Fig. 1) giving rise to a pro-embryo of three superposed cells (Fig. 2), characteristic of many Orchids. The uppermost (basal) cell now enlarges and divides by two vertical walls, intersecting at right angles (Figs. 3 to 7) so that a tier of four cells results. Each of these four cells divides by another vertical wall (Fig. 8), ultimately giving rise to eight cells (Figs. 9 and 9*a*). Figure 9*a* represents an optical transverse section of the stage indicated in Fig. 9, at the region of the dotted line.

Subsequent stages show that these eight cells elongate and almost engulf the embryo proper (Figs. 10, 12 and 13). Fig. 14 shows a mature embryo with the surrounding suspensor cells, which dwindle down and wither away at the time of the dispersal of the seed.

Somewhere at the 4-celled stage of the suspensor, the terminal cell of the pro-embryo divides by a longitudinal wall (Figs. 10 and 11); a similar division also takes place in the middle cell of the pro-embryo, resulting in a group of four cells (Fig. 12). The subsequent divisions are irregular and result in a spherical or oval-shaped embryo.

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June 5, 1942.

A PRELIMINARY NOTE ON THE STERILITY IN FLAX (*LINUM USITATISSIMUM*)

STERILITY in crop plants is of common occurrence and has been the object of extensive investigation by cytogeneticists. Bateson and Gairdner[1] reported pollen sterility in flax varieties studied by them. In the flax varieties, JLord, Liral purple, Liral monarch and Triumph, planted in the experimental plots of the Department of Agriculture, Bangalore, the writer observed that in many of the apparently ripe capsules only sterile seeds devoid of embryos and abortive ovules being present. A detailed investigation undertaken revealed female sterility which had not been reported so far, on a large scale. Developmental stages of the embryo-sac was traced with a view to find out the exact stage at which degeneration set in.

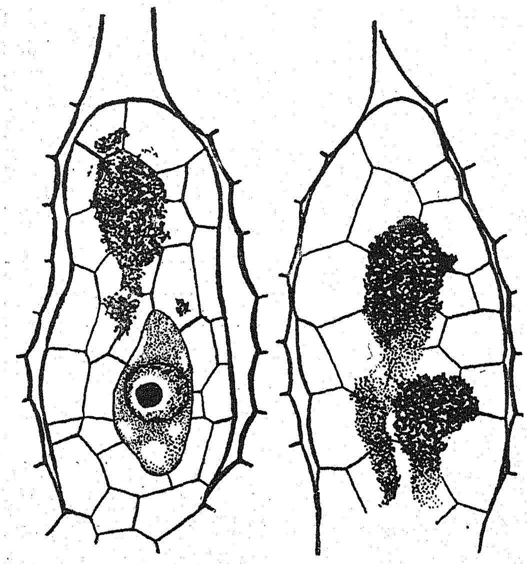

FIG. 1 FIG. 2

1. Section of ovule showing enlargement of the megaspore mother-cell before the usual heterotypic and homeotypic divisions. The degenerated mass seen is the degenerating nucellar cells. × 1520.

2. Degenerated mass of cells in place of a linear row of tetrads. × 1520.

The development of the embryo-sac conforms to the normal type. This feature has already been recorded by Schürhoff[2] for *Linum usitatissimum* and Soueges[3] for *Linum catharticum*. The archesporium is hypodermal in origin and cuts off the parietal cell. Occurrence of multiple archesporium has also been noticed but only one of them develops further. In normal cases the megaspore mother-cell (Fig. 1) undergoes the usual heterotypic and homoetypic divisions to form the linear tetrad of megaspores. The chalazal megaspore enlarges and forms the embryo-sac. In many cases (where there is sterility) the megaspore mother-cell enlarges in size and degenerates without undergoing the heterotypic divisions. In place of a

linear row of tetrads a degenerate mass of cells can be observed (Fig. 2).

Another interesting feature noticed was that in the case of sterile capsules not only the carpellary wall continues to develop to the same size as in the fertile ones but some seeds lacking embryos also develop. Such a feature has been observed in parthenocarpic type of development wherein the carpellary walls continue to grow due to the stimulus of pollen grains which in some instances affect similarly in the development of seeds having no embryos.

In conclusion, the writer wishes to acknowledge his grateful thanks to the Director of Agriculture in Mysore, Bangalore, for giving facilities to work in the Botany Section. He is also indebted to Dr. L. S. Dorasami, Economic Botanist, for valuable guidance and encouragement.

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Bangalore,
May 6, 1942.

1 Bateson and Gairdner, *J. Genetics*, 1921, **11**, 269–79.
2 Schürhoff, *Jahrb. f. wiss. Bot.*, 1924, **63**, 707–59.
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THE INFLUENCE OF PACKING ON THE MOVEMENT OF MOISTURE THROUGH THE SOIL

AIR-DRIED soil sieved through a 0·5 mm. sieve was packed in glass tubes of internal diameter 1·3 cm. A given mass of soil can be packed *loosely* without any obvious air gaps so as to occupy a certain *maximum* length in the glass tube. Later, when the glass tube is dropped from a height of 6″ repeatedly, the length of the soil column gradually decreases and finally it attains a *minimum* value which represents the *closest* packing possible by this process. Table I shows the volume (V in c.c.) occupied by 4 oz. of Poona (black cotton) soil at different stages of packing. The contraction in volume at any stage is expressed as a percentage of the maximum contraction possible by this method and is called the *percentage of packing*.

A rectangular metallic reservoir (Fig. 1) with 4 side openings on each of two opposite sides at a level of about 1½ inches above the bottom and containing water up to a constant level was used to feed water into 8 (replicates)

TABLE I

V. in c.c.*	99·30	97·05	94·30	91·80	89·30	87·30	84·30
Difference†	0·00	2·25	5·00	7·50	10·00	12·00	15·00
% of packing‡	0·0	15·0	33·3	50·0	66·6	80·00	100·0

* Volume occupied by 4 oz. of Poona soil in c.c.
† Difference in volume from that at minimum packing.
‡ % of packing.

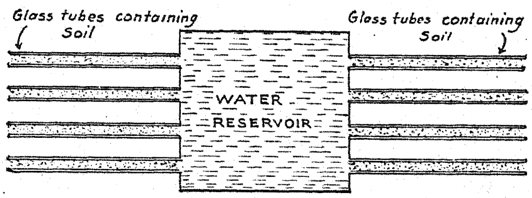

FIG. 1
Plan of apparatus for measuring movement of water through horizontal soil columns

tubes containing soil at a particular percentage of packing. The tubes were all kept horizontal so that the force drawing water from the reservoir was practically due to the capillary pull of the soil column, the constant head of water above the axis of the tube maintained in the reservoir being only 3 cm. Measurements of the lengths of the soil columns wetted by water were made at suitable time intervals. The experiment was repeated for each degree of packing. The mean lengths (the coefficients of variability were of the order of 5 per cent.) of the wetted soil columns have been plotted against the percentage of packing in Fig. 2. Each curve refers to a particular time interval after the commencement of the experiment. It is very interesting to note that the points referring to any particular time interval practically fall on a straight line. It is also of interest to note that all the straight lines meet the horizontal axis at the same point, *viz.*, 166 per cent., of packing, indicating that, if the soil had been packed by some other method by 66

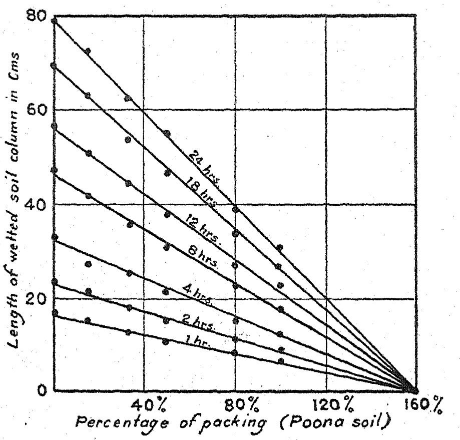

FIG. 2

per cent. more than was possible by the dropping method, a stage would have been reached when water *would not pass through the medium.* We may call this the "impervious" point.

Table II gives the volumes occupied by 4 oz. of Bangalore soil at different stages of packing.

TABLE II

V. in c.c.*	98·40	96·00	93·15	90·40	87·70	85·60	82·40
Difference†	0·00	2·40	5·35	8·00	10·70	12·80	16·00
% of packing‡	0·0	15·0	33·3	50·0	63·6	80·0	100·0

* Volume occupied by 4 oz. of Bangalore soil in c.c.

† Difference in volume from that at minimum packing.

‡ % of packing.

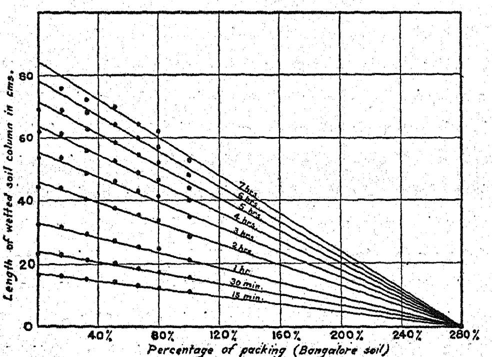

FIG. 3

The measurements of the lengths of wetted soil in tubes of Bangalore soil at different stages of packing were made in 8 replications as before. Fig. 3 shows the relation between the mean length of wetted soil column and the degrees of packing. Here also the relationship is linear and the straight lines all meet the horizontal axis at the 280 per cent. point. Thus the further packing necessary to reach the "impervious" point in this case is 180 per cent. more than the maximum packing actually achieved by the dropping method.

The "impervious" point appears to be a characteristic property of a soil and the investigation of other soils by this method is being taken up.

The author's thanks are due to Dr. L. A. Ramdas for suggesting the present investigation and for guidance.

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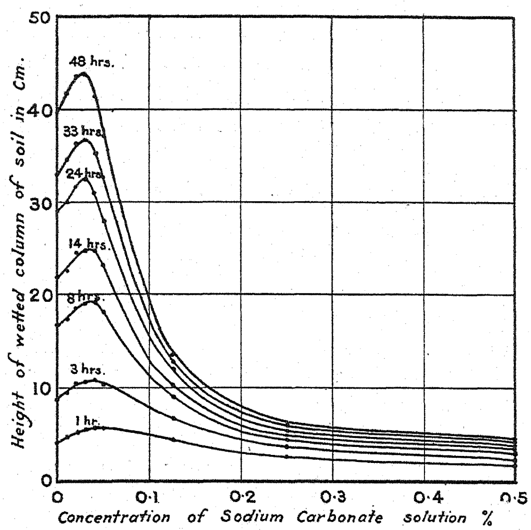
June 17, 1942.

THE EFFECT OF CONCENTRATION ON THE CAPILLARY MOVEMENT OF SOME SALT SOLUTIONS THROUGH THE BLACK COTTON SOIL

IN two papers due to appear shortly in the *Proceedings of the Indian Academy of Sciences,* Ramdas and Mallik have discussed the results of a series of experiments on some properties of the black cotton soil. It was found that salts, the solutions of which move less freely through the soil than pure water, caused *swelling* of the layer of colloidal material with which the particles of black cotton soil are coated.

The purpose of this note is to show the effect of increasing the concentration of the salt solution on the rate of its upward movement through vertical columns of the soil packed in glass tubes. Four replications of soil columns were used for each concentration starting with 0 per cent. (pure water) and ending with the

highest concentration which it was necessary to use in the experiments. We may describe here the results of the experiment using sodium carbonate. The figure shows the variation of the length (in cm.) of the soil



column visibly wetted by the solution, as a result of capillary ascent, with the concentration of the solution. Each curve in the figure refers to a particular time interval after the commencement of the experiment. It is very interesting to note that, as the concentration is increased from 0 per cent. (water) to about 0·03 per cent., there is an *increase* in the upward movement and that the well-known impermeability of the soil in the presence of sodium carbonate begins only when the concentration is increased beyond the above optimum value. The permeability of the soil decreases very rapidly as the concentration increases from 0·03 per cent. to 0·1 per cent., the decrease with further increase of concentration being less conspicuous. At a concentration of 1·0 per cent. the solution hardly shows any upward movement through the soil even after the lapse of several weeks. It may be remarked that the increase in the upward movement with traces of sodium carbonate is probably due to the slight constriction of the capillaries between soil particles due to incipient swelling of their colloidal coatings and the consequent increase in the upward pull. Further swelling causes choking of the capillary pores and consequent impermeability. Very similar results have been obtained with oxalic acid, sodium oxalate, lithium carbonate and the experiments are being continued with other salts.

L. A. RAMDAS.
A. K. MALLIK.
U. P. PANDIT.

Agricultural Meteorology Section,
Meteorological Office,
Poona,
June 10, 1942.

FUNGUS DISEASE OF GOURAMI (*OSPHROMENUS GORAMY* LACEPEDE)* IN A POND AT MADRAS

A POND in the Government House Gardens, Guindy (Madras), was stocked with 30 gourami fingerlings (*Osphromenus goramy*) ranging in size from 3″-7″ on 2nd April 1940, along with 100 Pearl-spot (*Etroplus suratensis*). In August 1941 the tank shrank to $^{1}/_{5}$th of its size, the depth of the water went down to 3′ 7″ at the deepest part and the water was thick and muddy. A trial netting was made and 4 gourami, 10″-11″ long (2 males and 2 females), 13 pearl-spot, 2½″-5½″ long and 1 climbing-Perch (*Anabas scandens*) were caught. Of the 4 specimens of gourami, 3 exhibited red patches on their sides.

On 17-9-1941 three hauls brought twenty-six gourami, one climbing-perch and one pond-tortoise: the latter two being predaceous, were removed. The sizes of the 26 fish ranged from 7″-12″, the average being 9½″ in length. All of them had fungus patches and were treated with 3 per cent. salt solution for a minute and released. As the attack of the fish by the fungus was common and persisting, it was found necessary to repeat the treatment.

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* With the kind permission of the Director of Industries and Commerce, Madras.

On 1-10-1941 a specimen of gourami, measuring 7½" in length, was taken to the laboratory for observation and treatment, as the fishes in the pond still had the attack. There were three reddish patches on the left side of the body, two in the middle and one one inch from the eye, dorsally and five patches on the right side, one at the base of the pectoral fin, two in the middle and two at the base of the caudal fin. The right eye was injured, bulging, opaque and dark brown in colour and the left eye, though not injured, was dark brown in colour. On examination, the red patches on the body showed the presence of *Saprolegina sp.,* a fungus which commonly attacks freshwater fish. This fish was kept in an aquarium in clear water after giving a saline bath. The water was changed twice a day and the fish fed regularly with leaves of water-lilies, vallisneria, boiled rice, and oil-cake. The reddish patches of fungus turned pale; the eyes became normal; the pale white colour of the fish changed to brown with a rosy hue. The fungus patches disappeared in about a week. The fungus though not harmful by itself, enables pernicious bacteria and other parasites to get a hold on the surface of the skin which destroy the tissues and cause great havoc to fish-life.

This fungus attack may be attributed to (1) overcrowding of the pond with fish, (2) pollution caused by decaying organic matter, (3) injuries caused in a limited area by enemies, such as the pond-tortoise and climbing-perch and (4) lipoid-disease caused by malnutrition. The above factors were noticed in the present case, except the lipoid-disease for which no examination was made. The pond in April 1941 had shrunk to $^1/_5$th of the original size, rendering the water area less roomy for the fish. The water was muddy and all the weeds, water-lilies, etc., had shrivelled up in the hot weather, thus depriving the fish of their chief food.

As it was also suspected that the disease might be due to some chemical factor, both samples of water—one of the pond in Guindy and the other in which the fish was kept for observation—were analysed,† for chlorine content, hydrogen-ion concentration and oxygen content, etc. The former differed from the latter in having a low alkalinity to methyl orange (2·4 per 100,000 as against 9·5 of the other), low pH (7·1 per 100,000 as against 7·6), a slightly higher oxygen content (0·171 per 100,000 to 0·158) and a less amount of chlorine (0·7 per 100,000 as against 4·6). In spite of the lesser percentage of oxygen and the higher amount of chlorine, the disease has been cured in the clear water in which the fish was under observation.

Mud in suspension chokes the gills of fish and renders respiration difficult with the result that the general conditions and health of the fish suffer deterioration. Besides, overcrowding caused by reduced environmental area is generally responsible for loss of health and condition of fish. The presence of enemies like the pond-tortoise and the climbing-perch had caused abrasions and loss of scales and injury to the fish in this instance. Such injured spots on the fish form the foci for the attack and spread of fungus diseases. The spread of the disease must have also been accelerated by the high temperature of the season and want of sufficient food.

K. CHIDAMBARAM.

Madras Fisheries Service,

April 3, 1942.

† The water samples were analysed at the King Institute, Guindy, Madras.

1 Davis, H. S., "Care and Diseases of Trout", *U. S. Bureau of Fish, Inv. Rept.*, 1937, No. 35.

2 Malik, G. M., *Bom. Nat. Hist. Soc.*, 1939, **41**, No. 2.

3 Mather, F., Plehn, M., *Praktikum Der. Fishkrankheiten*, 1909.

THE MANUFACTURE OF GLANDULAR PRODUCTS IN INDIA

THE note on the above subject by Prof. B. B. Dey[1] and its subsequent rejoinder by Dr. B. Mukerji[2] seem to be of considerable interest at this particular juncture. True it is that many things can be produced in India from the Indian raw materials; but in most discussions, symposia or in writings only one side of

the shield is being scrutinised. Prof. Dey points out that three and half lakhs of cattle are being slaughtered annually in the various cities of the country and these may be easily utilised for the manufacture of glandular products like adrenaline, pituitary extract, liver principles, etc., etc. It may be noted, however, that these animals too would not offer more than 0·7 million suprarenal glands which on no account would afford more than 100 ounces of adrenaline powder. Further the type of animals that are generally being slaughtered, would not offer the maximum amount of physiological principles[3] in question. Even the above maximum amount would not be sufficient for meeting the market already established for Liquor Adrenalin Hydrochloride of the manufacturing concern from which this note is being written. Similar question arises on the availability of sufficient amount of pituitary (posteriar lobe) powder within the country. Liquid extract of liver is another product which can, of course, be easily prepared and in practice this is being largely produced too. The difficulty, however, again arises with the isolation and standardisation of an active liver principle that might be suitable for parenteral administration in Indian cases. Extensive physiological and clinical investigations would be necessary for finding out the necessity or utility of one or other liver principle in this tropical country. Here bullocks, oxen and cows are used for cultivation work. The children of the soil are mostly poor and vegetarian, or, at least not beef eating. Thus the social, geographical and climatic conditions prevailing act as a bar in the progress of large-scale manufacture of glandular products within the country. Many products like adrenaline, testosterone, desoxy corticosterone, synthetic œstrone-like substances of course are now being produced in other countries in artificial way; but their successful productions in India depend on various other factors which are well known to economic industrialists and/or scientific politicians.

As has already been mentioned by Dr. Mukerji certain Indian commercial concerns are producing medicament of requisite standard from the materials that are already available in India. Unfortunately most of our scientists not in touch with Indian industrial concerns are unaware of this fact. It may, however, be stressed here that an all-cut drive and concerted efforts of the various scientists working in the different and divergent research institutions and industrial concerns of the country would have helped much in the production of still better, more and newer products. The spirit of such a concerted action is lacking and the existing firms apart from many other trade difficulties even suffer for want of facilities for clinical trials of their finished products in the authorised hospitals of the country.

U. P. Basu.
Bengal Immunity Research Laboratory,
Calcutta,
June 12, 1942.

1 This Journal, 1942, **11**, 110.
2 *Ibid.*, p. 198.
3 Basu, Bose and Das Gupta, *Indian Med. Gazette*, 1940, **75**, 215.

FATTY OIL FROM THE FRUIT OF *MARTYNIA DIANDRA* (N.O. *PEDALIACEAE*)

The fat from the dried fruit of *Martynia Diandra* (Marathi: *Vinchu*; English: *Devil's Claw*; Hindi: *Bichu*) collected from the neighbourhood of Kolhapur, has been analysed and the results given below. The fat was extracted with carbon tetrachloride in a soxhlet.

Yield—20 per cent. (on the weight of the dried fruit).
Colour—Orange.
Smell—Nothing characteristic.
Specific gravity at 23° C.—0·9528.
Refractive index at 23° C.—1·4720.
Acid number—15·42.
Saponification value—195·3.
Iodine value—75·62.
Reichert-Meissel value—3·877.
Polenske number—0·7825.
Acetyl value—10·79.
Unsaponifiable matter—0·86 per cent.

Rajaram College,
Kolhapur,
May 14, 1942.
S. V. Shah.
J. W. Airan.
A. V. Rege.

REVIEWS

Economic Control of Iron and Steel Works. By F. L. Meyenberg; with a Foreword by Sir William Larke. (Chapman & Hall Ltd., London), 1942. Pp. xx + 332. Price 25*s.*

The author of the book is an acknowledged expert in the subject-matter treated and is now living in England as a naturalised British subject. He was engaged for more than a dozen years, first in the German iron and steel industry and then as a Professor of Industrial Administration at a technical university, when he frequently participated in the meetings of the Committee of Works-Economics of the Verein Deutscher Eisenhuttenleute. He was employed by the British Iron & Steel Federation at the time when the "Uniform Costs System" was being compiled, and has been working in the British iron and steel industry for nearly seven years.

The purpose of the book as stated by the author is to discuss the individual parts of economic control and their connections with each other. Only the point of view of considering economic control as an inseparable whole of technical, commercial, administrative and psychological questions can produce the favourable result, which should reasonably be expected from the necessary clerical apparatus. The book deals with these problems from the point of view of the iron and steel industry, but the fundamental explanation can be considered as valid for industrial works generally.

The book describes in five parts the whole sphere of economic control:—accountancy proper and its results, the balance sheet and profit and loss account; works accounts, *i.e.*, costing systems in the individual departments of a large iron and steel works; job accounts—general equations of costs, production and sales statements; standard costs—their derivation and application in budgeting and estimating; and finally, the organization of economic control in which the author indicates proposals for improvement based on his experience, and logical conclusions.

The merits of the work have been fully dealt with in the Foreword by Sir William Larke, K.B.E., Director of the British Iron and Steel Federation. Sir William supports the author's view that the relationship between the accounting, commercial and production departments of works should be that of active and understanding co-operation. It is suggested by Sir William that this co-operation will undoubtedly be stimulated by a study of this book and that all those already in or aspiring to executive positions in the industry, whether technical, productive, commercial or financial, should carefully consider this book.

In India, the book ought to be welcomed by not only those who are concerned with the iron and steel industry, but by all who have anything to do in the management and planning of industrial works in general or are going to take part in the shaping of India's industrial future.

J. S. VATCHAGANDHY.

Science and Everyday Life.—By J. B. S. Haldane, F.R.S. (Pelican Books, Penguin Books Co., London and U.S.A.), 1941. Pp. 192.

This is an age when science has been continually influencing and dominating every aspect of human life and culture. It is, therefore, essential that the ordinary man and woman should not only try and understand the achievements of science but also realise their impact on his life and thought. Gifted thinkers like Professor Haldane have taken upon themselves the task of bringing this scientific knowledge to the door of the common man through the hospitality of the columns of the "*Daily Worker*".

The enterprising publishers of the widely appreciated series of Pelican books, have brought together some seventy of these articles as a compact and inexpensive edition, which is prefaced by Professor Haldane himself. The author has dealt in simple and clear language with a great variety of topics—meals, heredity, mathematics and physics, science and society, etc. This series of articles is all the more interesting because of the circumstance that Professor Haldane has happily mixed his own pet Marxist political philosophy with the facts of science. This is a collection which will be gratefully received by the common man

and constitute a guide to those who aspire to render science intelligible to the general public. V. S. G.

Animal Life. By J. R. Bhatt, Moratu Vidyalaya, Moratuwa, Ceylon. (Published by the author), 1941. Pp. iii + 253. Rs. 3.

This book has particular reference to animal life in Ceylon and the author who appears to be a teacher of Biology in that country has evidently an abundant interest in and intimate knowledge of the fauna of Ceylon and he has dealt with the subject in a manner intelligible to both the layman and the biologist. Everywhere the economic aspect of the animal life of Ceylon has been emphasised and the book gives a popular account of the bearing of the fauna of the island on human life and activity. The arrangement of the chapters does not indicate the sequence of zoological evolution but in beginning his book with an account of insects the author evidently has in his mind the great part they play in human affairs and the immense importance they have assumed in the lives of men. Ceylon, like India, is an agricultural country and insects of particular interest to the agriculturist have been given special treatment.

Generally speaking, the faunal life of Ceylon is not very different from that of South India and the educative value of the book is therefore not restricted to the island of Ceylon with which it mainly deals. The insects the author has described, the earthworm and the leech, the frog, the fish and the fowl, and the various mammals the author deals with are also denizens of peninsular India and *Animal Life* is therefore of as much value to students and teachers in South India as it is to those in Ceylon. The book is evidently very popular in Ceylon and there is every reason to believe that it will be just as greatly in demand in India also. B. R. S.

The Eternal Quest: Studies in Philosophy. By M. A. Venkata Rao. (Hosali Press, Bangalore), 1942. Pp. 254. Rs. 5 or 7*s*. 6*d*.

Dedicated quite appropriately to the "Spirit of Philosophy" and animated by the "motive" that "a variety of concrete Idealism able to meet Realism at its 'toughest' with a determination to do justice to every phase of problems, with a willingness to follow the method of analysis so far it can be followed with meaning (p. *iii*—Preface) Prof. Venkata Rao's book *Studies in Philosophy*, is sure to remind his readers of the sternly intellectualistic attitude of Hegel who is said to have gone on working with his speculative effort within ear-shot of a fierce fight and roar of cannons. "Philosophical studies" in 1942, the year of grace, which finds India threatened by unscrupulous aggressors would easily demonstrate that well-directed Indian cultural endeavour is always devoted to the Eternal Quest. In the publication under notice, Prof. Venkata Rao has brought together *eleven* essays many of which had already appeared in periodicals. Each essay is independent in itself, dealing with a specific topic or problem. Though throughout comparative study of Indian and European doctrines is attempted, three studies distinctively deal with "Karma and Kant's Postulates of Morality", "Christian Immortality and Hindu Re-incarnation", and "Bradley and Bhagavad-Gita".

In judging a collection of studies or essays on different problems of philosophy, a reviewer is sure to find himself at a disadvantage as the publication is not devoted to a development of a single theme or thesis. Each essay or study will have to be thus judged on its merits as an independent unit. I shall consider one or two as within the limits of this notice, it would be impossible to cover all.

In his study on "The Notion of Difference in Dvaita", Prof. Venkata Rao examines the criticisms urged against the concept of difference by adherents or advocates of Monism or Absolutism (Advaita) and comes to the conclusion that "Both are systems of idealism, for both uphold an infinite consciousness, but Advaita is pure idealism denying all otherness whereas Dvaita is concrete idealism accepting otherness as essential to the nature of reality" (p. 145). I am afraid the conclusion does not describe Dvaita as it is. Upholding of an infinite consciousness (spelt with small "i" and "c" by the professor) does not necessarily make or convert a system into Idealism. On the contrary, the issue both in Indian and European systems is between Idealism and Realism. Quite apart from consciousness, finite and infinite, Realism admits objects

and entities which are non-mental, non-ideational though these enter into the relation known as knowledge. Thus, the description of Dvaita as "concrete idealism" is a distortion. Dvaita is Realism. (In Indian philosophy *Tattva-vada* is contrasted with *Maya-vada—i.e.,* Realism is contrasted with Illusionism.) Dvaita is emphatically *not* the idealism of Spinoza, Berkeley, Bradley, Kant and others. It is not idealism at all. It must be observed that idealistic systems which make or enter into cheap compromises with Realism, and similarly, Realistic systems which coquette with Idealism "pure" or "concrete" must both be banned from decent metaphysical company. And then, "concrete idealism" is better contrasted with "abstract idealism". A system can both be "pure" and "concrete". There is no antagonism between the two. All attempts wherever and by whomsoever made to bring Dvaita under "idealism" must fail. Dvaita is Realism. Secondly, Idealism is not the only fashionable or rational world-view.

Again, Prof. Venkata Rao has drawn but a doubtful parallelism between Bradley's "My station and its duties" and the Gita ideal of "Svadharma". If, for instance, one, be he a peon or a prime-minister, does his duty and draws his salary would that be the "path of realisation"? (p. 221). Bradley does not touch even the remotest fringe of Karma-Sanyasa (Sankara) and Karma-Yoga (Ramanuja and Madhva) interpretations of the Gita. I am afraid such doubtful parallelisms may not promote correct and sympathetic understanding between the East and the West for the securing of which presumably they are drawn.

These comments, I must add in conclusion, will not touch the general excellence of the treatment of the different topics by Prof. Venkata Rao. After completing a study of the volume, readers will get just a picture of disjointed snap-shots of the problems of philosophy. "One is surprised", writes Prof. Venkata Rao, "at the wealth of philosophical material waiting to be interpreted" (Preface). He has ample opportunities for study and research and I am sure at the earliest possible one, he will concentrate his attention on some one work "waiting to be interpreted" and develop his thesis in an independent unified volume.

R. NAGA RAJA SARMA.

MILK IN RELATION TO HEALTH

MILK provides the closest approach to an ideal diet and it has a special value in the Indian dietary where it forms the only source of first class animal proteins. From the nutritional standpoint a consumption of 1½ lbs. of milk per day may be considered absolutely necessary for an adult. Repeated surveys that have been carried out on this subject in India have, however, shown that the consumption is far below this optimum. The latest survey of the Agricultural Marketing in India in their report on "Marketing of Milk in India and Burma"* shows an average *per capita* consumption of milk and milk products at 7 ozs. of milk per day. Milk from Indian animals is no doubt very rich in fat (average 6 per cent.) compared to that produced in other countries (average 3·5 per cent.) and if milk consumed in India is toned down to this lower fat percentage the *per capita* intake of milk would be increased to 10·5 ozs. Of course, it is a debatable point whether so much importance could be attached to fat alone. The protein percentage of milk of Indian breeds of cattle is no doubt slightly higher than in milk of Western breeds but this is nothing compared to the very high fat percentage in the former and the mineral salts are by no means higher. Hence this dilution cannot be justified from the nutritional point of view. Even considering this higher figure as correct there is still a very great and urgent need for increasing the production and consumption of milk in this country.

Fortunately the value of milk and milk products for human nutrition is well known to consumers in India and this has been preached by her sages from most remote times. This was not so in many other countries but once the science had proved the value of milk, people were quick to take advantage of these new discoveries and today India has much to learn from their example. The first essential for milk production is a well balanced food for the animals. India has about a third of the

* *Report on the Marketing of Milk in India and Burma* (Manager of Publications, Delhi), 1941, pp. iii + 54. Price As. 8 or 9 *d*.

world's cattle population but many of these animals have to live on straw. The tendency to breed animals without any planning further makes this shortage acute. It is thus quite essential to have a proper record of the performance of each animal with the object of keeping only the profitable ones and weeding out those that are unprofitable. In India the number of milch animals whose record is maintained comes to only about 0·03 per cent. This unthrifty character of indigenous cattle is further illustrated by the figure for the milk production quoted in the above report. The average annual milk yield for cows varies from 65 lbs. to 1,825 lbs. Buffalo in comparison, is a better milk producer but the controversy as to whether India should get all milk only from cows or buffaloes is premature. All these resources must be harnessed for to-day's needs. For the development of dairy industry on proper lines it is quite essential that breeding should be done on scientific basis and a record of every animal maintained. This will of course be beyond the economical means of individual farmers but much can be achieved by village co-operative organisations.

The greatest stimulant to milk production is to increase the demand for milk, and under Indian conditions the attention must be focussed on the rural areas. One of the striking points brought out by the Agricultural Marketing Report is that even in rural areas of important dairy districts about 20 per cent. of the families, including children, do not consume any milk or milk products. When there is a local excess of milk it is usually converted into ghee. One of the chief attractions for the villager to make ghee is no doubt the ready cash it brings. But this is rather an uneconomic method of disposing off milk as the price realised by sale of ghee is much less and also because quite a large amount of the "lassi" produced as a bye-product is, contrary to the general belief, wasted.

The milk problem in the urban centres of India is also acute. The most undesirable aspect of this problem is that about 60–70 per cent. of the milk requirement is supplied by the animals housed within the municipal limits. The cost of maintenance in such centres is necessarily very high and due to economic reasons there is any amount of cruelty practised on dumb animals. These animals are slaughtered as soon as they go dry and this is a great drain on the cattle wealth of the country, as usually the animals brought to the cities are the best of their type. This and restricted transport facilities make the price at which milk is sold in urban centres very high in spite of the fact that milk is delivered in a crude state, no processing or bottling is done and also the chemical and hygienic quality of the samples is doubtful. Adulteration is practised on an extensive scale. The report has suggested a tentative scheme for the distribution of milk in the urban centres which is worth considering as need for some such co-operative organisation is badly felt. The suggestion made in the report about "toning" of milk to a standard butterfat percentage is also very valuable. It is estimated that in urban areas about 46 lakh maunds of skimmed milk is produced as a bye-product of creamery butter industry and if this can be used to mix with our fat rich milk, the same quantity of milk can be made to go round further.

Another aspect of milk production to which so far little attention has been paid is its degree of cleanliness. Unfortunately it is very difficult to distinguish by ordinary human senses good from safe milk. The report gives some very enlightening illustrations under which milk is to-day produced and sold in the urban centres. They need wider publicity within this country to arouse the consumers from their apathy. Unless there is a genuine demand and appreciation for clean milk, producers can hardly be expected to pay much heed to the conditions of production. On the other hand, any indirect method of making bad milk good is sure to be expensive to the country in the long run. The universal practice is to boil the milk and though the extent of boiling differs in different parts of the country, on an average it can be estimated that at least 5 per cent. of all the valuable constituents are lost. Another common procedure is to keep the milk simmering all throughout the day in confectioners' shops. Here the loss of nutrients will no doubt be much greater.

Production of milk and particularly of clean milk are closely bound up with the market price. In almost all the countries where dairy industry has been organised the control of milk prices has been the first and essential step. The State also gives its full share in the organisation of the dairy industry. Without this help the state of things in these countries would not have

been much different from what prevails in India to-day. At present it is difficult to estimate whether the Indian producer is working at a profit or loss but from the few data that are available and their comparison with the cost as estimated on some of the systematically run farms, it is clear that the producer has to be satisfied if he does not incur any loss. For example, it has been shown that there was a steady fall in the price of wholesale milk during the last ten years. An industry that rests on such slender basis cannot progress. A thorough reorganisation is necessary. This need not necessarily mean an increase in the price of milk from what prevails to-day. It is estimated that the cost of running the Milk Marketing Scheme in England comes to less than 1 per cent. of the value of milk sold. This cost is insignificant considering the great boon it has proved to the community. Similar results could be achieved in India too.

In India dairying is pursued largely as a side line and the whole industry, though colossal in its magnitude, has an individualistic outlook. Production of milk and rearing of good milch animals are, on the other hand, quite intricate processes. Hence a new orientation in the outlook is essential. For progress, co-operation is necessary and for bettering the condition of the dairy industry the absence of village co-operative organisations is urgently felt. It is such co-operative societies alone that can decide the breeding policy, create means to put it in practice, the price at which every villager will sell his milk and milk products, the quality of food that will be grown, the quantity of milk every child in the village will receive and so on. These village centres may in turn be linked with consumer's co-operative unions in the urban centres and thus a countrywide organisation set up. When the rural areas are organised the urban problem will be solved automatically or at least without much difficulty. The object of such co-operative centres should not merely be more profit for its members. Side by side it must increase the consuming capacity of the members and by better education help them to select or produce right type of food.

The problem of nutrition is thus closely linked up with better organisation of the dairy industry of the country, for, better diet means always more milk. In the past few years the milk problem in India has been widely discussed and learned theses produced. It is now time to translate these suggestions into practice.

N. N. DASTUR.

CENTENARIES

Sharp, Abraham (1651–1742)

ABRAHAM SHARP, an English mathematician, was born in Bradford in 1651. After apprenticing to a merchant at Manchester, he moved to Liverpool and devoted himself to mathematics. From 1684 to 1690 he was employed under Flamsteed in the newly founded observatory at Greenwhich and in 1688 he graduated with extraordinary accuracy a mural circle for that observatory.

Sharp calculated π to 72 places and the logarithms of all numbers from 1 to 100 and of all primes upto 1100 to 61 places.

Sharp died near Bradford, 18 July 1742.

Dallinger, William Henry (1842–1909)

WILLIAM HENRY DALLINGER, an English biologist, was a Wesleyan minister by profession. From 1870 to 1880 he pursued microscopic researches into minute pathogenic organisms. This gave him a mastery of microscopical technique and earned him reputation for his classical investigations into the life-history of some micro-organisms, particularly flagellates. In one instance he had an individual monad under observation continuously for thirty-two hours. Incidentally he threw much light on the then controverted question of abiogenesis.

One of his investigations proved the futility of the ordinary precaution of boiling for sterilising. For it proved that though the temperature of boiling water was fatal to monads in an active state, their spores could stand a temperature upto 300°.

Dallinger died at Lee, Kent, 7 November 1909.

S. R. RANGANATHAN.

University Library,
Madras.

SCIENCE NOTES AND NEWS

Studies on the Photo-Chemical Activity of Mixtures of Vanadic Acid and Tartaric Acid.—The study of the relationship between pH and (1) optical rotation, (2) light absorption and (3) dark reaction, with mixtures of vanadic acid and *d*- or *l*-tartaric acid at $pH < 4 \cdot 0$ has shown the existence of negatively charged colloidal micelles of poly-vanadic acid-tartaric acid. These micelles exist in equilibrium with the hydrogen ions in the solution:

$$[x \cdot VO_3^-, y \cdot \overset{A}{H_2}T, Z \cdot H^+] \rightleftarrows [H^+]$$

$$+ [x \cdot VO_3^-, y \cdot \overset{B}{H_2}T, (Z-1)\,H^+] \text{ where } T = \text{Tartrate ion.}$$

The optical rotation and light absorption are due to the micelle B, whereas the micelle A is responsible for the dark reaction. The velocity of the oxidation of recemic-tartaric acid by vanadic acid has a higher value than that for *d*-, *l*- or *dl*-acids. This important observation lends support to the view of Cotton that a distinction must be made between the solution of a racemate and a simple mixture which is inactive by external compensation.

The photo-reduction of mixtures of vanadic acid and tartaric acid has been studied in the visible and ultraviolet regions at $pH > 4 \cdot 0$ where equimolecular complex ions of the type ($VO^-.HT^-$) appear to exist in solution. Einstein's law of photo-chemical equivalence holds good and a mechanism has been postulated for the photo-process.

The investigation of the influence of *d*- and *l*- circularly polarised light on some photo-chemical reactions involving circularly dichroic systems has shown that, where the anisotropy factor g is positive, the velocity of the reaction in *l*-light is greater than that in *d*-light; the reverse is the case when g is negative. This is observed in the photo-oxidation in *d*- and *l*-light of *d*- and *l*-tartaric acid by persulphate, using as catalyst circularly dichroic colloidal systems containing poly-vanadous acid. The above reaction with racemic acid results in the production of optical activity. This is an approach towards a complete 'asymmetric synthesis', resolution being effected purely by the agency of light.

Vanadic acid sol. exhibits circular dichroism in the visible region on exposure to circularly polarised light. The photo-reduction of the dichroic sol. by tartaric acid gives differences in reaction velocity with *d*- and *l*-light. It has also been found that even when the vanadic acid-tartaric acid mixture is not initially dichroic, exposure to *d*- and *l*-light results in induced dichroism in the mixture and also in differences in the velocity of the reaction. Circular dichroism is induced in reduced vanadic acid sol. also on exposure to *d*- and *l*-light independent of the nature of the reductant used for the reduction of the sol.

It appears that in the case of vanadic acid sol. as well as of reduced sol., circularly polarised light exerts a directive influence during the process of formation of micro-crystalline sol. particles and causes a transition from the isotropic to the anisotropic lattice structure. This anisotropy manifests itself as circular dichroism and as a differential velocity effect in photo-chemical reactions taking place in circularly polarised light. T. L. R.

Blood Groups in India.—Discussing the blood group data of twelve aboriginal tribes of India Eileen W. F. Macfarlane and S. S. Sarkar (*American Journal of Physical Anthropology*, 1941, 38, 4) consider that serologically the aboriginal tribes should be regarded as having two broad divisions, "one having the physical characters of the Paniyans or Maler with a low content of B and the other having the physical characters of the Oraons having a low content of A and more B". The Paniyans, Kanikkars and Chenchus of S. India have close relationship in blood groups to the Maler of Bihar, all the four being Dravidian-speaking tribes. Though the Malers and Oraons are neighbours, their blood groups are quite dissimilar. The Bhils and Korkus of Central Provinces have like the Oraons a high percentage of B. "There is in general an increase in the frequencies of genes A and B from South Northward, and in groups B and AB from East to West across Central India". The authors suggest that the Mundari-speaking peoples possibly entered India later.

Nutritional Experiments with Chickens.—As a result of a series of experiments for the investigation of growth-promoting supplements to the basal diet of chicks consisting of locally available cereals, green food and calcium in the form of crushed limestone, Macdonald (*Ind. J. Vet. Sci. & Animal Husbandry*, 1941, 11) has shown that separated milk during the first 6 weeks and separated milk and water from 6 weeks onwards as supplement are essential to ensure proper growth, health and efficiency of the chicks. Where milk is not available or is too costly, soya bean meal and silt with cereals are recommended as the next best. S. D. A.

Goat Spleen Tissue Vaccine as an Immunizing Agent against Rinderpest.—By controlled experiments and by field tests on a large scale, Nair and Krishnamurti (*Ind. J. Vet. Sci. & Animal Husbandry*, 1941, 11) have confirmed that Rinderpest goat spleen tissue vaccine is potent only for four days at room temperature and that, if used within this period, it confers satisfactory immunity. But the duration of the immunity so conferred is not worked out by the authors yet. They have also confirmed the earlier findings that the reaction set up by the vaccine is often very severe in susceptible cattle and in buffaloes which are more susceptible to rinderpest than the local cattle and they

conclude that this product is unsafe for use in the field in the Madras Presidency.

In Mysore, Rinderpest goat blood virus is used, as it does not involve unnecessary animal sacrifice and as the duration of immunity conferred by it has been worked out by controlled experiments both in Mysore and elsewhere. This vaccine is used alone on indigenous cattle but with varying doses of serum in the case of buffaloes, foreign and cross-bred cattle, pregnant and debilitated animals. S. D. A.

The Geology of Ceylon.—The recent issue of *Spolia Zeylanica* (Vol. 23, Pt. 1)—the Journal of the Colombo Museum, edited by its Director, Mr. P. E. P. Deraniyagala,—contains a number of papers by Mr. D. N. Wadia, Government Mineralogist, dealing with some aspects of the Geology of Ceylon. As is well known, this island was till very recently part of the South Indian Peninsula and therefore shares with it many common features in its geological history such as those relating to the nature of the rocks, geological structure, and plan of architecture. Like Peninsular India Ceylon is mostly composed of extremely ancient crystalline and metamorphic rocks which in the history of the earth constitute the very foundation on which the later fossiliferous sediments were laid down elsewhere. The solitary occurrence of an Upper Gondwana bed near Tabbowa is of special interest in indicating the fact that Ceylon was also part of the great Gondwana continent; and the deformations which the Tabbowa series have undergone enable us to date the most important event in the geological history of Ceylon —the final upwarp of the central *massif*—and fixes it as post-Jurassic. During the enormously long period of time which has elapsed since the ancient Archæan rocks of Ceylon were deposited, they have been subjected to a continuous process of erosion and disintegration resulting in consequences of direct economic benefit to Ceylon; for it has liberated in a concentrated form many valuable economic minerals previously locked up in a vast bulk of the parent barren rock. Thus are to be accounted the famous Ratnapura gem fields, the Pulmoddai and Batticaloa ilmenite beaches, the Induruwa monazite sands, etc.

"The Geology of Colombo and its Environs" forms the subject of another paper by Mr. Wadia in which a detailed account of the geology of this part of the country is given, showing that here we have "an epitome of the geology of the whole island of Ceylon". The Archæan rocks of the area—mostly gneisses—described under the name 'Vijaya Series' constitute the main rock formation, overlying which locally we have a few recent and subrecent deposits here and there such as laterite, river alluvia, etc. The deposits of graphite for which Ceylon is so famous, are associated with rocks which have been provisionally designated as equivalent to the Khondalite Series of India.

In another short paper by Mr. Wadia, special attention has been drawn to the ring of waterfalls in Central Ceylon and its bearing on the geological structure and earth movements. In the words of the author, "the existence of precipitous falls disposed in a crescent or ring form suggests that the central highland *massif* of Ceylon, from which the majority of the rivers of the country radiate out fanwise, has received a considerable uplift relatively to the country surrounding it".

The other papers published in the Journal are:—(*i*) On a Fossil Bamboo Stem and Some Associated Plant Remains from the Gem Deposits of Ratnapura Dt., Ceylon—by Mr. G. S. Puri, of the Botany Department, University of Lucknow, and (*ii*) On Some Earthworms from Ceylon—by Mr. G. E. Gates, of the Judson College, Rangoon.

Messrs. A. H. Patel and G. Narasimhamurthy write:—"Of the many problems that seriously engage the attention of the Public Health worker in India, the one concerning the place of *Hydrogenated Vegetable Fat in the National Diet* is very important. In the West 'Margarine' is the most common fat food consumed to a great extent and it contains about 10 per cent. of butter fat, besides the hardened vegetable and animal fats. The case is different in India. Ghee is commonly served as such at meals and the untreated vegetable fats are used for culinary purposes. Hardened vegetable fats are an innovation to this country. The sentiment for ghee is so strong that propaganda was carried out that the Vegetable Product is indigestible and that it passes off from the human system as a ballast. (N. N. Godbole, *U. P. Anti-Ghee-Adulteration Conference*, Aligarh, 1941.)

Physiological work relating to the digestibility of this product in India is very meagre and the existing evidence is not found sufficient to condemn the product outright. The notion that ghee supplies vitamins A and D to the body, besides being very digestible is not quite true, because in the way it is processed and marketed, most of the vitamins are liable to get destroyed. Its digestibility compared to the other vegetable fats is not too high to justify the high price paid for it.

May I request your readers to throw more light on the subject for the benefit of all concerned, through the columns of your esteemed Journal."

Cement as a Fire Extinguisher.—Dr. Roy Cross writes in a recent number of *Science* (1942, 95, 275), that "a good deal of caution must be used in the application of pitch to extinguish fire, even though it originates from a magnesium incendiary bomb. It has been the experience of the writer with a great variety of fires in oil, metals and other materials, that there is nothing so satisfactory and so fool-proof as portland cement as it is placed on the market. In many cases in the writer's experience it has been highly successful in extinguishing fires where water, carbon tetrachloride, foam and similar substances have been unsuccessful. The very common material so easily available and so safe to use should be placed at points where there is danger from fires either from incendiary bombs or from normal causes.

"In our own laboratory, we provide such material easily available in kegs and find it far more successful than the usual fire extinguishers. Furthermore, it gives off no injurious gases and is in itself not combustible, as in the case of pitch."

The Differential Resistance of Two Races of Red Scale (Coccidae-Hemiptera-Insecta) to HCN.—Interesting observations on the reactions, to HCN, of the two physiological races of *Aonidiella aurantii* Mask—the one resistant and the other non-resistant to it—were made using examples of two pure stains from California (Hardman, N. F., and Craig, R., *Science*, 1941, 94).

Final instar females of both the resistant and non-resistant races were removed from their hosts before fertilisation; they were confined in suitable glass vials and observed closely under the microscope. Several dilutions of HCN were let into the vials and the spiracles of the scale insects were carefully watched. In structure, the spiracles of the two races are similar, the opening and closure of the organs being simultaneous with every pulsation of the tracheal trunk, which happens about 60 times every minute.

The spiracles of the resistant race remained closed for at least 30 minutes, in the presence of HCN, and the scales themselves survived a lethal concentration for at least that period. In the non-resistant race, the spiracles opened only a minute after HCN reached them, and death followed in a short time when the concentration of HCN was lethal. It is concluded that the relative ability of the two races to keep their spiracles closed when in contact with HCN, explains the difference in the resistance of the two races to the gas.

Control of Damping-off in Seed Beds.—*Pythium de Baryanum* causes damping-off seedlings and particularly causes severe loss in tobacco nurseries. The affected seedlings fall prostrate on the ground, and the collar region of the seedling appears to be pinched off, beginning to rot in due course. Since the infection is soil-borne, powerful fungicides cannot be applied without injurious effects to the roots. The usual nursery practice is to sterilize the surface of the soil by inceneration, which is done by burning dry twigs on the seed bed. 10 per cent. formalin water is also made use of in controlling damping-off with good success. The seed beds after treatment with 10 per cent. formalin water are covered with gunny bags to conserve the effect of formalin. After this treatment the soil is raked up to enable the complete evaporation of formalin which is poisonous to the plant. The whole operation requires 7 to 8 days.

Recently satisfactory control of damping-off in seed beds of lettuce, beet, cabbage and tomato plants has been reported by Doran (*Science*, lxxxlv) by the application of acetic acid in the form of vinegar. Commercial cider vinegar is mixed up with powdered charcoal or moist sand up to 23 per cent. The seed beds dusted with this disinfectant is reported to be free from damping-off to a very great extent.

M. J. T.

Hot-Tinning of Mild Steels.—Difficulties are frequently encountered in hot-tinning of certain mild steel articles and components. The Tin Research Institute Publication No. 107, by *W. E. Hoare and H. Plummer* describes how these difficulties may be overcome by removing the contaminated surface by mechanical treatment, deep-etching and anode pickling, or by controlled heat-treatment. "Difficult" tinning quality is ascribed to the formation of adherent lacquer-like films arising from the rolling and drawing lubricants and coolants being partially decomposed in contact with the metal surface by heat and possibly by oxidation and pressure and may be avoided by adequate degreasing prior to the annealing operations.

Calcium Gluconate.—Bulletin No. 29, of the Department of Industries and Commerce, United Provinces, embodies the results of a systematic investigation by *J. B. Lal and K. C. Mukherji* on the manufacture of calcium gluconate by the electrolytic oxidation of glucose. The cost of production on the laboratory scale, works out at Rs. 2-3-0 per lb., and it is expected that this will be much reduced when produced on a larger scale and by using locally made glucose, costing 4 annas a lb.

The Forest Research Institute, Dehra Dun, announces a method (*Indian Forest Leaflet* No. 19) for the preparation of a substitute for 'Carnauba Wax' using indigenous materials (shellac wax, bees' wax, and sal dammar). It is claimed that the substitute has properties very similar to 'Carnauba Wax' which is an essential base for the manufacture of carbon papers, polishes, etc.

V. S. G.

Substitute for Metal Drums and Cans.—Substitute containers to take the place of the usual metal drums and cans used for oils, paints, greases, dry goods and other stores have been evolved by the Forest Research Institute.

Owing to the diversion of much tin and sheet metal to army use, manufacturers in India are in sore need of substitute containers. The Institute anticipated this shortage many months back and started experiments on different types of plywood containers. It has now evolved many different designs of plywood drums, containers, canisters, boxes and buckets.

The plywood canisters used for food, dry goods and medical stores are normally lined with a shellac varnish unless required for some purpose which demands a special lining. The drums with iron bands round the top, centre and bottom, are made of strong plywood and are designed for oils, greases and paints. Various inner coatings have been tried and some have already passed the army tests. Ordinary glue is said to be a satisfactory inner coating for oils and greases.

Containers for Parachute Dropping.—Plywood buckets are coated on the inside with hard pitch which renders them waterproof. The round flat containers, specially designed to fit into larger containers made for dropping by parachute are proofed to hold water both for drinking purposes and for machine-guns.

Plywood prototypes of metal boxes can be used for a variety of purposes, such as for tubes of anti-gas grease, hypodermic phials, powders and pills.

Plywood factories in India have already started the manufacture of plywood drums on the lines of the models made at the Forest Research Institute. Plywood drums and containers may be widely adopted not only as a war-time expedient, but also in times of peace. They are easy to make and they should compete favourably with the metal articles.

River Behaviour and its Control.—A new subject—River behaviour, training and control —important for the maintenance of canal headworks and the training of rivers through bridges, figured prominently on the agenda of the annual meeting of the Research Committee of the Central Board of Irrigation in Simla which held its session from July 14 to 18.

Progress has been made in the study of river behaviour at the research stations. The task now undertaken by the Board and its Research Committee is, however, probably the first attempt in India to deal with the problem by a Committee of engineers and research workers.

Two other subjects included for the first time are "Soil Mechanics", in connection with earthen dams and canal banks, and "rainfall run off", dealing with the quantity and rate of discharge of floods from catchments of various sizes.

Among other subjects for discussion are: flow in rivers and canals, hydraulics of boulder rivers, methods of measuring discharges, design of distributory heads, design of canal falls, silting of reservoirs, staunching of canals to prevent loss of water and water-logging of lands.

Quality of Indian Wool.—For the first time in the history of India, a serious effort is made to compile data on the qualities and quantities of wool available in different parts of India [*Handbook on the Quality of Indian Wool* (Manager of Publications, Delhi), 1942. Pp. 49. Price As. 8 or 9*d*.]. The information collected has been carefully and systematically arranged, and the national importance of the Indian wool industry and the place it occupies in the international trade is clearly brought out. Though the quantity of wool produced in India is only about 2·4 per cent. of the world's output, the actual quantity is 85 million lbs., valued at about 4·2 crores of rupees per annum. The average yield per sheep is the lowest in the world, being about 1·9 lbs. per sheep per annum; the quality is again the poorest according to existing classification, though a fair percentage of it, if properly graded, can be used for the manufacture of better classes of goods and fetch high prices. This is clearly indicated in the tables on pages 36, 37 and 38 of the *Handbook*. Some useful suggestions have been made for the proper grading of Indian wool under "Proposed Classification" which, if followed, would result in securing a higher return to the sheep-rearer.

The subject of sheep-rearing and its economic importance to India has not received the close study it deserves, and it is hoped that a detailed study will be taken up in the near future.

The present study of Indian wool, according to the Central Agricultural Marketing Department, is not by any chance exhaustive. Even in Provinces and States where considerable amount of money has been spent over long periods in improving the stock of sheep, very little systematic data on the qualities of wool produced are available. That there is an urgent need for such a scientific study of wool produced in India, is impressively brought home by the present publication which deserves careful study. The fact that Australia which to-day ranks first among the wool-producing countries of the world had only 20,000 sheep yielding an average of 3 lbs. of coarse wool per sheep per annum, in 1,800, and that by systematic and scientific study, she has improved her stock to 1,015 millions, yielding about 9 lbs. of the finest quality wool per sheep per annum, should be enough to impress on all those concerned with the welfare of India and her large agricultural population the urgent need for applying scientific principles for improving the stocks of Indian sheep and thus place this industry on a secure and prosperous basis. B. K. MURTHY.

"Spotless" Sun for Two Days.—Studies on the intensity of radiation from sun spots relative to the surrounding photosphere have revealed that the character of the radiation from a sun spot is independent of its position on the disc.

The theoretical study on the motion of gases in the sun's atmosphere and the experimental work on Zeeman-effect were continued. The occurrence of highly stripped atoms of iron, nickel, cobalt, etc., in the Corona has been investigated on the basis of the results of the dynamical study of the solar envelope. The conclusions so far reached indicate that these atoms probably originate in the interior of the sun at a depth of about 25,000 km. or more.

In 1941 a further fall in solar activity was indicated by several solar phenomena such as sun spots, prominences and hydrogen absorption markings. Observing conditions were slightly less favourable than in 1940.

Photographs of the sun in ordinary light were obtained on 322 days while spectroheliograms in calcium and hydrogen light were secured on 302 days and 262 days respectively. Under the existing scheme of co-operation among observatories, 63 photographs were obtained from observatories in England and America and 302 calcium disc spectroheliograms were sent from this Observatory to the Solar Physics Observatory, Cambridge.

Laxmi Narayan Institute of Technology, Nagpur.—We have pleasure in announcing that Dr. S. A. Saletore, Ph.D., has been appointed as Director of the Institute. Dr. A. Nagaraja Rao, of the Imperial Institute of Sugar Technology, Cawnpore, has been appointed Professor of Applied Physical Chemistry in the same Institute.

The Indian Ceramic Society was revived in March 1941, and the headquarters shifted to the Ceramic Department of the Benares Hindu University. The first number of the *Transac-*

tions was issued in September 1941, and the second number, which is under review, in April 1942. It is hoped to establish a central ceramic library and also a museum of ceramic products and Indian raw materials from which they are made. Contributions of technical books, journals, samples of manufactured goods and raw materials, with details of place of manufacture and occurrence, etc., may kindly be sent to the Hon. Secretary, The Indian Ceramic Society, Department of Ceramics, Benares Hindu University, Benares.

The University of Ceylon.—We have pleasure in announcing that the University of Ceylon was formally inaugurated at Colombo on the 14th July 1942, by Dr. Ivor Jennings, the first Vice-Chancellor of the University.

Ceylon's education was hitherto linked up with the University of London and although the creation of an independent University for Ceylon was under proposal for some years its inauguration so soon would not have been possible but for the extraordinary energy and enthusiasm of Dr. Jennings. His efforts have thus resulted in giving a fillip to the much desired want in the educational system of the island.

The University is residential with faculties for arts and sciences, Oriental languages and medicine for the present. It is learnt that the faculty of law would be added later on.

The University of Delhi.—Academic circles in India will learn with pleasure and satisfaction that the University has been offered a gift of £2,500 by the Rhodes Trustees, towards the endowment of any professorship or lecturership and preferably one of Political Science or English. This is in token of their good will and appreciation of the work now being done by the University.

SEISMOLOGICAL NOTES

During the month of June 1942 five slight and two moderate earthquake shocks were recorded by the Colaba seismographs as against one very great, three moderate and three slight ones recorded during the same month in 1941. Details for June 1942 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
		H.	M.	(Miles)		(Miles)	
4	Slight	12	37	4210	..	100	
6	Slight	20	23	5430	..	..	
10	Slight	15	51	3630	..		
14	Slight	08	40	5070	..	100	
14	Slight	20	00	3640	..	50	
18	Moderate	15	01	4540	..	..	Epicentral region in the neighbourhood of the Lanthe Shoal among the Cardine Islands.
24	Moderate	16	56	8110	Near Lat. 40°S., Long. 180° in the neighbourhood of the North Island, New Zealand.	..	Reported to have been felt at Wellington and other places in North Island, New Zealand. Heavy damage to property was done at Masterton and Palmerston. South Island was only very slightly affected.

MAGNETIC NOTES

June 1942 was less disturbed than the preceding month. There were 20 *quiet* days and 10 days of *slight* disturbance as against 22 days of slight disturbance and 8 of moderate disturbance during June 1941. The day of largest disturbance during June 1942 was the 11th and that of least disturbance the 10th. The character of individual days was as follows:—

Quiet Days	Slightly disturbed days
1, 2, 4–10, 15–18, 20–22, 24–27.	3, 11–14, 19, 23, 28–30.

No magnetic storms occurred during the month of June 1942 while three moderate storms were recorded during the same month last year. The mean character figure for the month was 0·03 as against 1·27 for June 1941.

M. R. Rangaswami.

Colaba Observatory,
July 17, 1942.

ANNOUNCEMENT

The Director, Government Test House, Calcutta, has been pleased to notify as follows:—A wide variety of materials, including textile goods, electrical equipment and stores, building and general engineering materials, vacuum brake fittings, metals and alloys, minerals and ores and miscellaneous stores, such as oils, lubricants, paints, varnishes, chemicals, fuels, etc., etc., are tested in the Government Test House, Alipore, Calcutta, to determine their qualities. The charges for tests and analyses are laid down in the "Schedule of Charges" issued by the Government of India. There are two "Schedules of Charges"—one for the Government Departments and the other for private firms and individuals. Copies of these Schedules are obtainable at a nominal price from the Government Book Depots.

The facilities for testing provided in that Office are available to the general public no less than to Government Departments. Fees are charged for all tests carried out and test certificates bearing the Government seal are issued for all samples tested. Such test certificates can be used by firms and individuals for commercial purposes.

The Government of India are alive to the difficulties which nascent and undeveloped Indian industries may experience in getting their products tested at the Government Test House on payment of fees at the scheduled rates, and have given their anxious consideration to the question of affording some measure of relief in the matter of fees in cases which stand in need of such concession. The question of revision of the schedule of fees is under consideration, and pending a final decision on the subject it has been decided, as an experimental measure for a further period of one year, to reduce the testing fees to a certain definite extent in cases where Government are satisfied as to the need for concession.

Firms and individuals intending to take advantage of this concession are requested to apply to the Director, Government Test House, Alipore, Calcutta, substantiating their claim to such concession.

The Government of India have also made provision for the total exemption from payment of fees in specially deserving cases, and firms and individuals, who consider themselves to be in that category, should apply to the Director, Scientific and Industrial Research, University of Delhi, Delhi. On receipt of such applications, the Director, Scientific and Industrial Research, will arrange matters with the Government Test House if he considers that tests free of cost are justified.

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts:" Vol. 90, Nos. 4607, 4609, 4610 and 4612.

"Journal of Agricultural Research," Vol. 64, Nos. 5-6.

"Agricultural Gazette of New South Wales," Vol. 53, Pt. 4.

"Journal of the Indian Botanical Society," Vol. 21, Nos. 3 and 4.

"Indian Forester," Vol. 68, No. 7.

"Transactions of the Faraday Society," Vol. 38, Pts. 4 and 5.

"Indian Farming," Vol. 3, No. 6.

"Indian Central Jute Committee," Vol. 5, No. 3.

"Review of Applied Mycology," Vol. 21, Pt. 3.

"Nature," Vol 149, Nos. 3773, 3776-80 & 3782.

"American Museum of Natural History," Vol. 49, No. 3.

Books

"Essays in Anthropology," presented to Rai Bahadur Sarat Chandra Roy. Edited by J. P. Mills, B. S. Guha, K. P. Chattopadhayay, D. N. Majumdar and A. Aiyapan. (Maxwell & Co., Lucknow), 1942. Pp. 268. Price Rs. 12 or £1-1.

"Vitamins in Nutrition." (Merck & Co., Rahway, N.J.), 1942. Pp. 32.

"An Introduction to the Chemistry of Cellulose," by J. T. Marsh and F. C. Wood. (Chapman & Hall, London), 1942. Pp. xv + 512. Price 28*sh*.

"Organic Chemistry," by P. B. Sarkar and and P. C. Rakshit. (H. Chatterjee & Co., Ltd., Calcutta), 1942. Pp. vi + 562. Price Rs. 5.

ERRATA

Vol. 11, No. 6, June 1942, page 242

In the legend below Fig. 1, *read* "right" *for* the word "left" within the brackets. In the right half of the page, line 3, the word "right" should be read as "left".

842-42—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science", Bangalore.

CURRENT SCIENCE

Vol. XI] AUGUST 1942 [No. 8

THE NATURE OF THE LIQUID STATE

THE characteristic properties of the liquid state may be grouped under various headings, the most familiar being the mechanical properties, *viz.*, the capacity to transmit hydrostatic pressure, the viscous resistance to flow and the tension exhibited by free surfaces. The elucidation of these and other physico-chemical properties of liquids in terms of their molecular structure is one of the major problems of physics to which a great deal of attention has been given. Laplace's theory of capillarity, and Van der Waal's equation of state are the classic examples of attempts to explain liquid behaviour. They are typical of the purely theoretical approaches to the subject in which hypothetical assumptions regarding the properties of molecules or the nature of the liquid state form the starting point, while the resemblance between the conclusions drawn from the theory and the experimental facts of observation is regarded as an indication of the truth of such assumptions.

That a wholly different approach to the problems of the liquid state is possible became apparent from the investigations undertaken by the present writer in 1921 in order to explain the dark blue colour of transparent oceanic waters. Observations made during sea voyages in that year suggested that this phenomenon had its origin in the molecular diffusion of light in great depths of clear water traversed by sunlight. This explanation was confirmed by laboratory observations which showed that dust-free water traversed by a beam of light exhibits a feeble blue opalescence. The intensity of this opalescence was found to be in fair accord with a formula originally

developed by Einstein from the thermodynamic theory of density fluctuations to explain the enormously stronger effect observed in fluids at the critical temperature. It soon became clear, however, that Einstein's theory did not cover all the facts, and that the diffusion of light in liquids was in reality a molecular phenomenon, and that its detailed study could be expected greatly to enlarge our knowledge of the liquid state of molecular aggregation.

As is well known, a substance may exist in different physical states, *e.g.*, a gas or a vapour, a liquid, an amorphous glass or a crystalline solid. One of the most important questions regarding the liquid state is that of its relation to the other possible states of molecular aggregation. The comparative study of the molecular diffusion of light in the different physical states of a substance is very helpful in enabling the nature of the differences between these states to be understood. The most readily observed changes are those of the *intensity* of the diffused light. This is a maximum in the gaseous state when considered in relation to its density, and a minimum in the crystalline condition, while the liquid and the amorphous solid usually occupy the intermediate positions in the order stated. The scattering of light, though fairly intense and therefore easily observed in liquids, is usually much feebler than the scattering in the vapour if the far greater density of the liquid is taken into consideration. These facts stand explained when it is recalled that the molecules in a vapour are distributed in space at random and in a crystal with geometric regularity, while they indicate that the space-grouping in the liquid and in the amorphous solid is very far from being chaotic, though it does not possess the complete regularity characteristic of crystals. If we accept the thermodynamic theory of Einstein, the compressibility of the substance is, in each case, a measure of the spatial uniformity of distribution. The smaller the compressibility, the more nearly perfect would be the uniformity of the space-distribution of the molecules, and the more completely, therefore, would the secondary radiations from the molecules cancel each other out by interference.

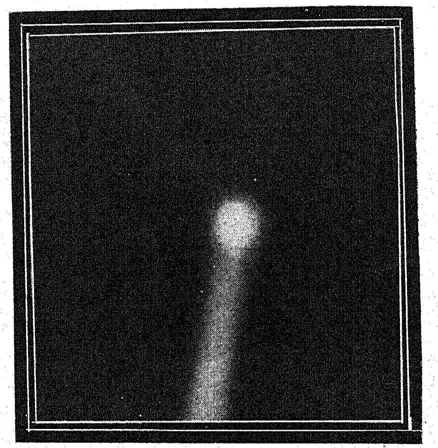

Fig. 1

Volume and surface scattering of light in liquid methyl alcohol
(Photograph by P. S. Hariharan)

We have next to consider the orientations of the molecules in a liquid. In the crystal, as we know, these orientations form a geometrically regular pattern and taken together with the optical anisotropy of the molecules determine the optical birefringence of the crystal. Since liquids are optically isotropic, it follows that there can be no regularity of molecular orientation when averaged over any volume of

macroscopic dimensions. We are justified, however, in asking whether there is any tendency for neighbouring molecules to align themselves similarly or to form groups in which near neighbours stand in some definite relationship. Comparative studies of the intensity and the state of polarisation of the light scattered transversely in vapours and in the corresponding liquids furnish valuable evidence on this as indicating that the orientation scattering is larger in the liquid than in the vapour when considered in relation to the density. Indeed, in most cases, the reverse is true; the larger depolarisation of the total scattering in liquids is due to the fact that the reduction of the intensity per molecule of depolarised orientation scattering is not so great as that of the polarised density scattering in passing from vapour to liquid.

(*a*)

(*b*)

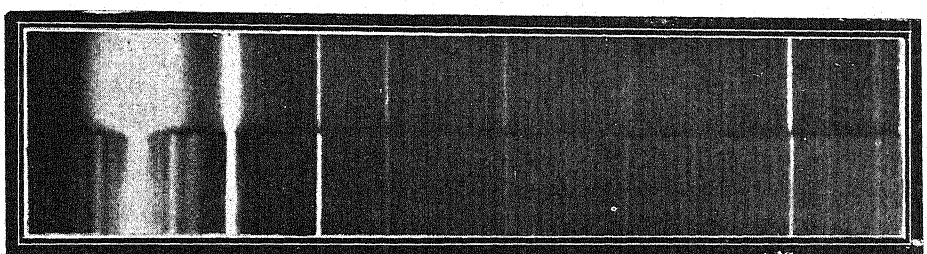

FIG. 2

Spectrum of light scattered in (*a*) molten and (*b*) solid naphthalene
(Photograph by R. Norris)

point. The optical anisotropy of the molecules in a fluid or amorphous solid gives rise to an "orientation" scattering which is depolarised to the extent of 6/7, and is therefore readily distinguished from the fully polarised "density" scattering associated with the isotropic part of the polarisability of the molecules. It is readily shown that if groups of neighbouring molecules in a liquid were similarly orientated, the orientation scattering would be enormously enhanced in its intensity as compared with its intensity for a state of completely random orientation. Actually, we find that the depolarisation exhibited by the light diffused within a liquid is usually much more striking than the depolarisation of the light scattered by the vapour. This cannot, however, be regarded

Thus, the phenomena of light scattering give no support to the idea often expressed that liquids have a micro-crystalline structure. Neither is such a supposition true for the amorphous solid state. On the other hand, there is good reason for the belief that the liquid and the amorphous solid states stand in the closest relation to each other. The well-known fact that liquids may sometimes be super-cooled without crystallisation occurring and made to pass over into the glassy condition is a *prima facie* indication of that such a relationship exists.

The study of light scattering enables us to obtain a much deeper insight into the nature of the liquid and solid states of aggregation when, as was done by the present writer early in 1928, the mono-

chromatic radiations of the mercury arc lamp are employed and the aid of the spectroscope is enlisted for such studies. The changes of frequency then observed in the scattered radiations are of two different kinds in the case of liquids. Firstly, we have new lines appearing in the spectrum with fairly large and discrete frequency shifts; secondly, a continuous spectrum of radiations with altered frequency is also noticed. The latter effect is most conspicuous in the vicinity of the original lines of the mercury arc, taking the form of "wings" stretching out in the spectrum somewhat unsymmetrically on either side of these lines. To describe this phenomenon as a broadening of the spectral lines, as has been done by some writers, would be incorrect. Fig. 3 represents the group of four lines in the vicinity of 4358 A.U. in the light of the mercury arc scattered by benzene liquid and photographed with a Hilger 3-meter spectrograph. It is seen that the "wing" has its maximum intensity at the wavelength of the incident radiations; its presence, however, does not influence the spectral width of these radiations. As is evident from the figure, these radiations when not overexposed continue to be seen as lines of extreme sharpness in the spectra.

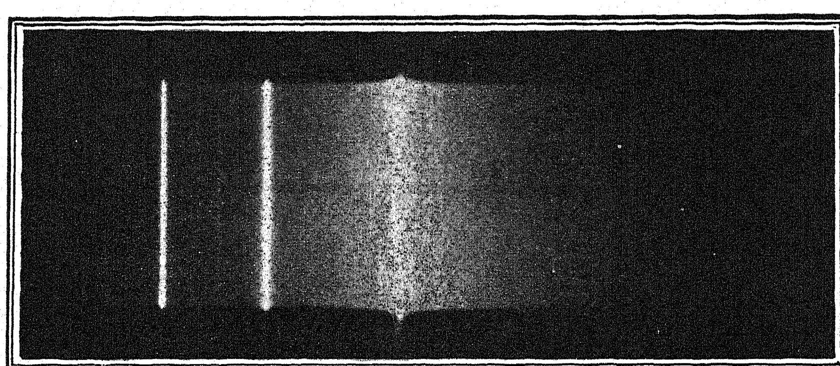

FIG. 3

Rotation " wings" in the spectrum of light scattered in benzene liquid
(Photograph by C. S. Venkateswaran)

The origin of these "wings" has been the subject of much discussion. The experimental evidence which has accumulated, however, clearly supports the explanation of the same suggested in 1928 by the present writer and K. S. Krishnan. In the first place, the wings are fully depolarised to the extent of 6/7 in all the cases so far studied. Secondly, they appear in the same region of moderately small frequency shifts as that in which the rotation of the molecules in compressed gases and vapours and in liquid hydrogen records itself in light scattering. Thirdly, the "wings" are most intense in liquids containing ions or molecules which have a high degree of optical anisotropy, *e.g.*, fused inorganic nitrates and aromatic compounds. Fourthly, when the substance is in the crystalline state, the wing disappears, and is replaced by discrete lines exhibiting a wholly different distribu-

tion of intensity (see Fig. 2). Fifthly, when the liquid is cooled down into the amorphous solid state, the wings become very weak and practically disappear. These observations clearly indicate that the "wings" are principally in the nature of "orientation" scattering and arise from the rotation of the molecules or molecular groups within the liquid. Here, again, the facts give no support whatever to the hypothesis of a micro-crystalline structure for liquids.

We now proceed to consider the character and origin of the scattered radiations which are recorded by the spectroscope in the same position as the radiations of the mercury arc. As stated above, the "wings" accompanying these lines represent depolarised orientation scattering. The question naturally arises, do the undisplaced lines consist only of polarised density scattering or do they include also any depolarised orientation scattering? This question is obviously of great importance and has been exhaustively investigated at Bangalore by Mr. B. D. Saxena and more recently also by Mrs. K. Sunanda Bai. These authors used a Littrow prismatic spectrograph by Hilger with a high resolving power to analyse the transversely scattered radiations and determine their state of polarisation. With the spectrograph slit opened very wide, the depolarisation of the total scattering by the liquid could be determined and came out practically the same as that observed without spectroscopic analysis. The slit was then made very fine to give the full resolving power of the instrument, and thus enable the depolarisation of the "undisplaced" scattering to be measured. It was found that in every case this was partially polarised and that the difference between the "wide slit" and "narrow slit" values of the depolarisation ratio depended greatly on the viscosity of the liquid and its temperature. The difference was found to be quite small for highly viscous liquids, *e.g.*, formic acid, benzophenone and glycerine, and much more marked in mobile liquids as also in viscous liquids at high temperatures. It was clear from the observations that the "undisplaced" scattering included a notable amount of depolarised orientation scattering, the proportion of this to the polarised scattering increasing with the viscosity of the liquid as well as with the optical anisotropy of the molecules contained in it.

In order to further elucidate the nature and origin of the "undisplaced" radiations observed in light scattering, C. S. Venkateswaran and more recently also K. Sunanda Bai have carried out elaborate studies, using a Fabry-Perot etalon for a spectral analysis of these radiations and a Lummer-Gehrcke plate to determine their state of polarisation. Investigations of this kind are not easy, and only by a careful choice of suitable interferometers and of the light sources and the most exacting care in experimental technique is it possible to obtain reliable results. It is not surprising, therefore, that these new investigations fail to confirm many of the conclusions stated by earlier workers in this field and in fact throw a completely new light on the subject.

A few remarks may appropriately be made here regarding the thermodynamic theory of light-scattering. Einstein considered the density fluctuations to be static and isothermal, while in the theory of

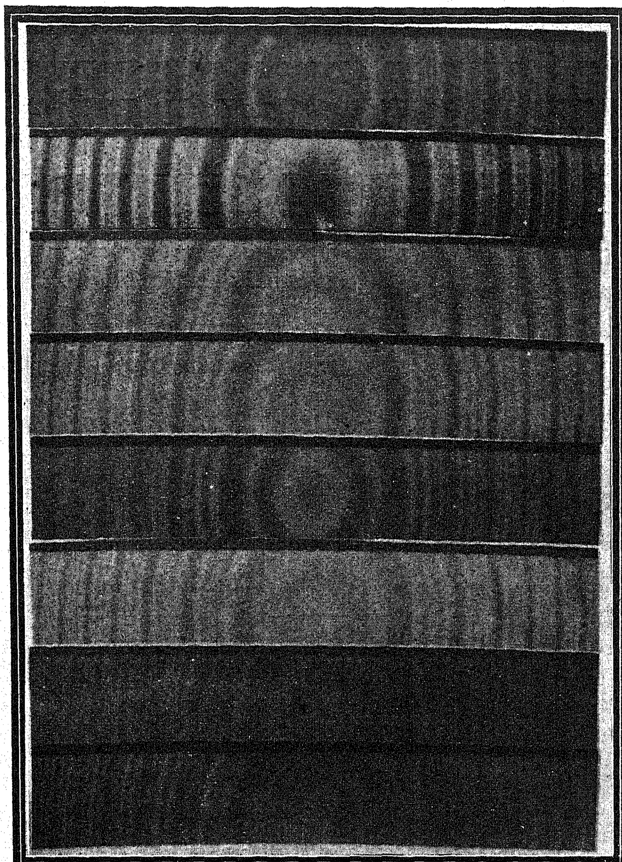

FIG. 4

Fabry-Perot patterns of light scattering in the alcohols (4078 A.U. Hg arc)

(*a*) methyl, (*b*) ethyl, (*c*) *n*-propyl, (*d*) *iso*-propyl, (*e*) *n*-butyl, (*f*) *iso*-butyl, (*g*) *iso*-amyl, (*h*) allyl alcohol

(Photographs by K. Sunanda Bai)

Brillouin they are considered as dynamic stratifications or sound-waves and therefore presumably adiabatic in character. The assumption that the fluctuations of refractive index arising from the density fluctuations are connected with them by the well-known Lorentz formula is neither necessary nor justifiable. The adiabatic piezo-optic coefficient of several common liquids has been recently determined at Bangalore by the present writer and K. Venkataraman. Using these coefficients and assuming the density fluctuations to be adiabatic in character, Sunanda Bai has recalculated the intensity of light scattering given by the thermodynamic theory and compared it with her own observations. When the presence of the depolarised orientation scattering is taken into account, the observed intensities are found to support the adiabatic hypothesis rather than the isothermal one.

It must not, however, be concluded from this approximate agreement of the observed and calculated total intensities that the thermodynamic theory of light-scattering is either correct or complete. The Fabry-Perot patterns of mobile liquids obtained by Venkateswaran exhibit a continuous band overlying the central or undisplaced component and the outer or Doppler-shifted components indicated by the Brillouin theory and suggest that these are imperfectlv resolved. In less mobile liquids, the components are more clearly separated. A central component is observed in all cases and is found to exhibit a clearly noticeable defect of polarisation, while the outer components appear to be polarised, though whether such polarisation is complete is open to doubt. The relative intensities of the central and outer components appear to

be controlled by two distinct factors, one being the viscosity of the liquid and the other the optical anisotropy of the molecules. The more viscous the liquid, the stronger the central component relatively to the outer ones. A greater optical anisotropy of the molecules appears to have a similar effect.

The outer or Brillouin components clearly owe their origin to the thermal agitation of the liquid. How does the central component arise? The most natural supposition is that it is due to the fundamental structure of the liquid which is akin to that of a glass or amorphous solid. This hypothesis is supported by the observation that its intensity relatively to the outer comopnents increases with the viscosity of the liquid, in other words, with the approach of the fluid to the amorphous solid state. Since the molecules would occupy fixed but random orientations in the amorphous solid, the presence of both polarised and depolarised components in the light diffused by it without any change of frequency is readily understood.

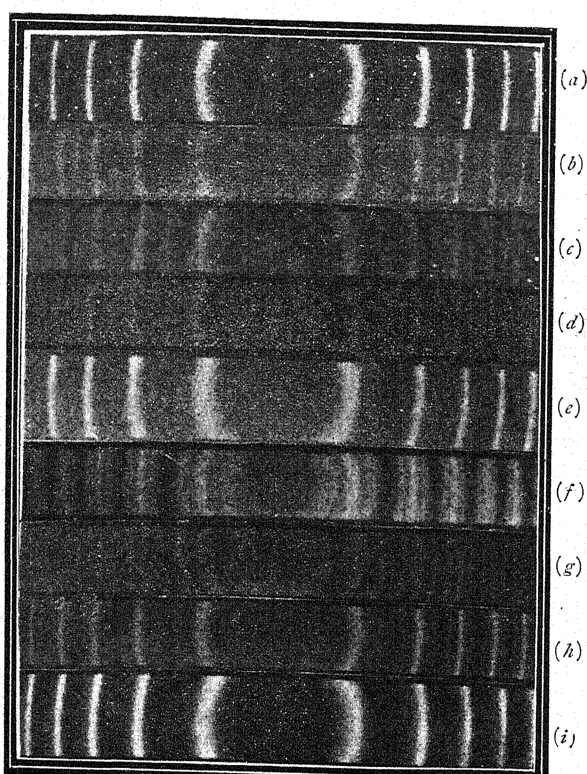

FIG. 5

Fabry-Perot patterns of highly viscous liquids

(a) Glycerine (0° C.), (b) Glycerine (26° C.), (c) Glycerine (42° C.), (d) Glycerine 110° C.), (e) Castor oil, (f) Cyclohexanol, (g) Glycol, (h) Phenol, (i) Styrol glass

(Photographs by C. S. Venkateswaran)

Further striking confirmation of these ideas is furnished by Venkateswaran's measurements of the hypersonic velocities in viscous liquids from the spectral displacements in the Fabry-Perot patterns. For ordinary or mobile liquids, the hypersonic velocity comes out practically the same as the ordinary ultrasonic velocity observed at much lower frequencies. But in the highly viscous liquids glycerine and castor oil, there is a marked difference between the two velocities and it is noticed that this difference falls off with rising temperature. A very satisfactory explanation of these facts is furnished by the consideration that for sufficiently high frequencies of vibration, a viscous liquid may to all intensities and purposes be regarded as an amorphous solid, and the hypersonic velocity should therefore depend both on its compressibility and the rigidity coefficient.

The experimental facts of light-scattering may thus be summarised in the statement that the basic structure of a liquid is the same as that of the corresponding amorphous solid, though disturbed and enlarged by thermal agitation. Precisely the same

conclusion is indicated by the study of the X-ray diffraction haloes (see Fig. 6) in liquid and glass. Indeed, the fundamental relationship between the phenomena of light-scattering and the X-ray effects was pointed out as long ago as 1923 in a paper by the present writer with K. R. Ramanathan. It is the same orderliness of molecular spacing which explains the diminished light-scattering which is also responsible for the diminished intensity of diffraction at small angles as compared with the vapour which is the most characteristic feature of the X-ray haloes of both liquids and amorphous solids.

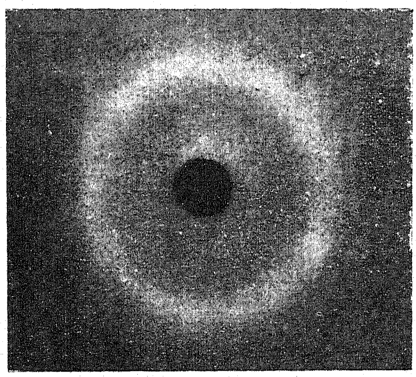

FIG. 6*a*

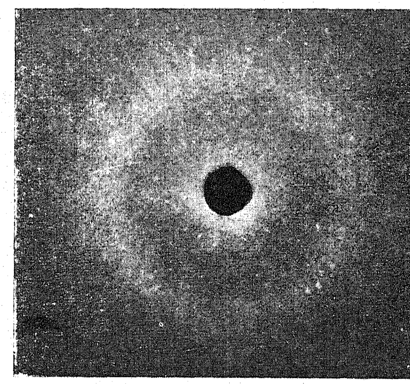

FIG. 6*b*

X-ray halo of glycerine, (*a*) glass and (*b*) liquid
(Photographs by T. M. K. Nedungadi)

C. V. RAMAN.

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

DR. SIR S. S. BHATNAGAR has made over a sum of approximately Rs. 13,000, which he has personally earned as royalties this year, to the Council of Scientific and Industrial Research for the purpose of financing research workers engaged on schemes of research in operation under the Board of Scientific and Industrial Research irrespective of whether the work is carried out under his direction at Delhi, or under the direction of any other recognised director of research, elsewhere in India. The help will be given to those workers who have earned no royalties, as their work had to be given in the interest of the war effort or development of industry. A part of this donation will be utilised for preparing an oil painting of the Hon'ble Dewan Bahadur Sir A. Ramaswamy Mudaliar, whose name is so intimately associated with the promotion of industrial research in this country. A sum of Rs. 1,000 will be donated to the Delhi University for encouraging scientific and industrial researches and a further sum of Rs. 2,880 has been earmarked for granting two scholarships of Rs. 60 each for two years in the Punjab University.

Messrs. Tata Sons have made a munificent grant of Rs. 8,30,000 to the Council of Scientific and Industrial Research for the construction and equipment of a National Chemical Laboratory. The Laboratory will be located at Poona and will be associated with the name of Tatas.

A donation of Rs. 1,00,000 to the Council of Scientific and Industrial Research has been made by Messrs. Indian Wire and Steel Products Ltd., for carrying out such work as may be agreed upon between the donors and the Council.

—(By courtesy of the Editor, *Journal of Scientific and Industrial Research.*)

THE CHEMISTRY OF THE ANTI-PERNICIOUS ANEMIA SUBSTANCES OF LIVER

BY

Y. SUBBA ROW

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THE efficacy of whole liver in the remission of pernicious anemia was first demonstrated in 1926, an observation which has since then been fully confirmed. In spite of several attempts by various investigators, the isolation of the active principle in a state of chemical purity and integrity has so far been unsuccessful but there has been a notable advance in the purification and potency of liver extracts. In view of the several divergent points of view regarding the chemical nature of the active material, it appears desirable to describe and review the work of closely allied groups of investigators together, before passing to that of another. This method of preparation, it is hoped, will, in preference to the strictly historical one, give a clearer perspective of the contributions of each worker in this field.

We shall not discuss the clinical aspects of pernicious anemia nor deal with the now widely accepted theory of the roles of the "extrinsic" and the "intrinsic" factors which, from a chemical view-point, have not so far been identified.

The claim of Klein and Wilkinson[47] that the active thermostabile principle of liver can be synthesized *in vitro* by incubating beef muscle and hog stomach extracts, could not be confirmed by Castle.[4]

We will not concern ourselves with the antianemic substance reportedly present in normal urine[88,76,15,77,53,43] nor attempt to decide whether the antianemic-principles found in the kidney,[59] lungs,[36] brain, salivary glands, saliva,[72] pancreas and other organs, are the same chemically as that associated with liver.

We will only refer to "a new therapy of pernicious anemia" with a spinach extract, a report, which is not supported by experiment.[64] No attempt is made to review the interesting observations of Massa and Zolezzi,[55,56,57] and of Mermod and Dock[60] on the use of congo red.

We shall deal only with the substance or substances in liver which exert a beneficial influence in cases of pernicious anemia.

Early Therapy and Assay

Before Minot and Murphy, there had been scattered suggestions in literature that pernicious anemia is a deficiency disease.[18,47] Whipple *et al.*, during the treatment of severe secondary anemia in dogs induced by repeated hemorrhage, observed the favourable influence exerted by the feeding of beef liver; they suggested that food factors be given serious consideration in the clinical management of pernicious anemia.[82,83] In 1926, Minot and Murphy reported the prompt and distinct improvement in a large number of pernicious anemia patients on a diet in which liver was an important constituent. Within two to eight days of such treatment there occurred an increase in the reticulocytes of the circulating blood, reaching a maximum on the third to tenth day and subsequently returning to the lower original level. With continued liver therapy, this reticulocyte response was followed by a rise in hemoglobin and total red cell count, with a return to an approximately normal blood picture in about two months. This blood response, chiefly the reticulocyte rise and return of red cells to normal number, has formed the basis of the clinical assay of potent preparations. Inasmuch as the chief difficulty in the work on the purification of active materials has been the relative scarcity of pernicious anemia patients, many worthy attempts have been made to develop an animal assay; the guinea pig, dog, cat, pigeon, swine, monkey and rabbit have all been tried without definite success in any. Creskoff and Fitz-Hugh have covered this subject admirably in their review on the standardization and assay of liver extract.[10] The clinical assay still is the only reliable way of following the fractionation procedures.

Fractionation of Liver by Cohn, Minot and Associates

In 1927, Cohn, Minot and their collaborators attacked the problem of the isolation of the active material from beef liver.[5,6,7,8,9] Table I summarizes their steps of fractionation. A major step in the purification procedure was the treatment of a concentrated

TABLE 1

Raw Minced Liver
brought to pH 9·0

INACTIVE FRACTIONS	ACTIVE FRACTIONS
Insoluble Residue (A)	Water Soluble Extractives brought to pH 5·0
Protein Precipitate (B) (acid-precipitable proteins)	Water Soluble Extractives heated to 70° C.
Heat Coagulable Proteins (C)	Water Soluble Extractives (D) extracted with ether
Ether Soluble Extractives (EE) [Removes 2 pct. of solids (D)]	Non-ether Soluble Extractives (E) extracted with strong alcohol
Alcohol Soluble Extractives (F) [Removes about 30 pct. of solids (D)]	Alcohol Precipitable Extractives (G) dialyzed
Dialyzed Extractives (H)	Dialysate (I) treated with silicic acid gel (pH 5)
Extractives Adsorbed by Silicic Gel (J)	Filtrate (K) extracted with *n*-butyl alcohol
Residues of *n*-butyl Alcohol Extraction (M)	Extractives (L) precipitated with basic lead acetate
Lead Precipitable Extractives (N)	Filtrate (O) precipitated with phosphotungstic acid
Filtrate from Phosphotungstate (Q)	Precipitate (P) phosphotungstates treated with 90 pct. acetone
Acetone-soluble Phosphotungstates (S)	Acetone-insoluble phosphotungstates (R)
	Starting with precipitate (P) regenerated and treated with 95 pct. alcohol
Insoluble Residue (peptones, proteoses, polypeptides)	Extract concentrated
	Intravenous Extract "I.E."
	"I.E." dissolved in 90 pct. alcohol, added equal volume of ether
Filtrate (contains tryptophane, tyrosine)	Precipitate. Treated with 1 volume H_2O: 9 vol. alcohol: 4 vol. ether
Precipitate (large number of substances giving diazo test)	Filtrate. Treated with 1 vol. H_2O: 12 vol. alcohol: 6 vol. ether
Filtrate (extracts phosphorus-containing substances)	Precipitate (Z). Treated with 11 vols. alc.: 6 vol. ether: 1 vol. H_2O.
	Precipitate (this is the fraction that has hitherto been precipitated by $HgSO_4$ in acid solution). Treated wtih picric acid.
	Precipitate (extremely active). (Effective in 140 mg. dose).

aqueous extract of liver (D) with an amount of absolute alcohol to result in a final alcohol concentration of 95 per cent.—the active precipitate is Cohn's Fraction G—which proved effective when fed daily in amounts of 9–14 grams (equivalent to about 200–400 grams of whole liver). A later modification was the treatment of the aqueous extract with alcohol to 70 per cent., the active principle remaining in solution with the precipitation of a good deal of inactive solids. They were able to eliminate proteins, fats and carbohydrates from the raw beef liver without a noteworthy loss in activity. The purer fractions contained less phosphorus and a greater percentage of nitrogen leading to the inference that "the active principle is either a nitrogenous base or a polypeptide".[6] On purer fractions the biuret test was negative and hydrolysis produced no increase in amino nitrogen. In highly purified solutions, heavy metals appeared to destroy activity. They believed that the active principle is free from proteins, carbohydrates, lipoids, tryptophane, tyrosine, arginine, cystine, creatinine, iron, sulfur and phosphorus.[8] Cohn's group concluded in 1930[8,9] that the active principle was a nitrogenous base, the nitrogen in which exists as in a secondary or tertiary amine. The low nitrogen content (10·8 per cent.) appeared to exclude purine or pyrimidine bases, but not ring compounds of the pyrrole or pyridine types. It seemed unlikely that it was a pyrrole because it gave no pine-splinter test characteristic of certain pyrroles. Their most active preparation (picric acid precipitate) proved active when given parenterally in a 140 mg. dose.

Early Work by West and Associates

West and Nichols in 1928[78] reported a product which showed a positive biuret test, a weakly positive Hopkins-Cole reaction and a positive test for arginine. West and Howe in 1930[79,80] prepared a product which proved active on intravenous injection of 680 mgm.; their best fraction appeared to be rich in a nitrogenous body with acid properties which on hydrolysis set 50 per cent. of its nitrogen free as amino-nitrogen. A crystalline quinine salt which at first seemed active clinically turned out later to be inactive.[81]

Later Work by Dakin, West and Associates

In 1935 Dakin and West[12] introduced the precipitation of the active material by Reinecke salt in acid solution, with subsequent removal from a weak alcoholic solution of the Reinecke acid as the sparingly soluble salt of a tertiary base (*e.g.*, dimethyl aniline) or by extraction with amyl alcohol. Table II summarizes the steps in their fractionation. 80 mg. of their Anahaemin gave a maximal clinical response. Hydrolysis of this active preparation yielded a group of amino acids. Complete absence of pyrimidine and purine bases, pentoses and desoxyglucose was reported. Later work by Dakin, Ungley and West in 1936[13] convinced them that the amino-hexose (glucosamine), which their previous preparation contained, was not an integral part of the active principle; they obtained further purification by introducing the precipitation of the active material by uranium (Table III). Their purest preparation at this time yielded on hydrolysis: arginine, glycine, leucine, aspartic acid, hydroxyproline and perhaps proline. There was also indication of a dicarboxylic acid easily soluble in water and giving a very soluble copper salt precipitable by alcohol—possibly hydroxyglutamic acid. From dialysis experiments through membranes of known pore diameter, they tentatively assigned a molecular weight between 2,000 and 5,000. The conclusion reached by Dakin, Ungley and West, as stated in 1936, was "that the hematopoietic substance in liver is, or is associated with, a peptide, possessing many but by no means all of the properties of an albumose". Recently Dakin and West[14] reported a few experiments on the precipitation of their material with albumose precipitants, including nucleic acid bile, taurocholic and other bile acids, and the barium carbonate reaction of Seigfried; the first three reagents yielded precipitates containing much active material.

Work of Laland, Klem, Strandell and Associates

Strandell and associates in 1935 and 1936[66,67] have reported the clinical assays of materials isolated by Laland and Klem.[52] Their procedure of fractionation—as summarized in Table IV employs phenol for the elution of the active material after adsorption on charcoal.

Dakin and West in 1935 found they could salt out the active substance by three-fourths to complete saturation with ammonium sulfate. Laland and Klem also found that

TABLE II

Commercial Liver Extract

treated with calcium acetate in 75% alcohol

FILTRATE
Removed calcium by ammonium oxalate, and alcohol by evaporation under reduced pressure. Precipitated with Reinecke acid and regenerated by dissolving in CH_3OH and precipitating the Reinecke complex with dimethyl aniline (Clinically active)

PRECIPITATE
Dissolved in H_2O, removed Ca, precipitated with Reinecke acid and regenerated (Clinically inactive)

Salted out in neutral or feebly acid solution (aqueous) with $(NH_4)_2SO_4$ (3|4 or more saturated), repeating process several times

PRECIPITATE (Product I)
Removed salts with alcohol, and barium acetate (Clinically active when regenerated)

FILTRATE
Removed salts and precipitated with Reinecke acid (Clinically inactive both before and after Reinecke separation)

Dissolved Product I in H_2O

Salted out repeatedly with $MgSO_4$

Precipitated as oily picrate (Clinically active)

Precipitated with flavianic acid

PRECIPITATE
Product IV
(Clinically active)

FILTRATE
(Clinically inactive)

PRECIPITATE (Product II)
Removed salts as above
(Clinically active) (Anahaemin)

FILTRATE (Product III)
Removed salts, precipitated with Reinecke acid and regenerated (Slight clinical activity)

Salted out repeatedly with NaCl

Neutral NaCl ppt. 43 per cent.
(Clinically active)

Acid NaCl ppt. (0·2 N HCl) 50 per cent.
(Clinically active)

such treatment of their fractions yielded active material, although the antianemic principle was not precipitated quantitatively even by full saturation.

By a series of steps, the exact details of which have not yet been reported, Laland and Klem have obtained an active fraction "BBaBFu.s.E", 0·00035 grams of which correspond to 100 grams of liver. This material is a bright reddish-yellow, non-crystalline acidic substance, easily soluble in water, partly soluble in alcohol and insoluble in ether. They reported absorption bands in two regions of the ultraviolet range at 2500–2650Å and 3450–3500Å. The ninhydrin reaction was negative; the orcin test, positive. After hydrolysis, amino nitrogen as well as acidic and basic amino acids have been detected.

53 mg. of Heptomin II (corresponding to about 200 grams of liver) showed antianemic activity when injected intraglutially.[66] Their purest preparation "BBaBFu.s.E" when administered parenterally gave a satisfactory hematopoietic response in a dose of 0·7 mg. (corresponding to 200 grams of liver).[67] The Scandinavian workers regard their product as a biuret negative peptide.

APPLICATION OF LALAND AND KLEM PROCEDURES TO DAKIN AND WEST MATERIAL

Ungley in 1936 further purified an active Dakin and West fraction by the methods of

TABLE III

Liver Extract Power

1 kg. dissolved in warm H_2O (2·5 L); added $(NH_4)_2SO_4$ (1·4 kg.); in refrigerator overnight

ACTIVE — INACTIVE

PRECIPITATE — **FILTRATE**

Washed with saturated $(NH_4)_2SO_4$ soln. and dried; stirred in H_2O (500 c.c.); filtered

FILTRATE — **RESIDUE**

Reprecipitated by saturation with $(NH_4)_2SO_4$

PRECIPITATE — **FILTRATE**

Suspended in H_2O (200 c.c.); added alcohol gradually (500 c.c.); in refrigerator

FILTRATE — **PRECIPITATE**

(of ammonium sulfate and alcohol-insoluble peptide)

Concentrated under diminished pressure (less than 50° C.); added basic lead acetate (200 gm. in saturated aqueous soln.) and NH_4OH until solution was alkaline to litmus; filtered immediately

FILTRATE — **PRECIPITATE**

Acidified to Congo red with H_2SO_4; filtered to remove $PbSO_4$; precipitated active material with Reinecke acid (about 25 gm.); regenerated the Reineckate; added uranium acetate (150 c.c. saturated solution)

CURDY PRECIPITATE — **FILTRATE**

Washed well with cold H_2O; dissolved in H_2SO_4 (0·5 N); added $(NH_4)_3PO_4$ (2 gm.) and neutralized with NH_4OH to remove uranium as its insoluble phosphate; solution again subjected to precipitation with basic lead acetate (15 gm.), freshly prepared lead hydroxide (5 gm.), and NH_4OH added so long as a precipitate was formed.

FILTRATE — **PRECIPITATE**

(Contained no glucosamine) Peptide recovered by acidifying with H_2SO_4; filtered off the $PbSO_4$; precipitated with Reinecke acid (3 gm.); regenerated the Reineckate; concentrated the decomposed Reineckate and precipitated with absolute alcohol

On decomposition with H_2SO_4, contained all of the glucosamine present in the product of the previous step.

SOLID PEPTIDE

(4·02 gm.) (Glucosamine-free)

TABLE IV

FRESH HASHED LIVER

Extracted with H_2O with addition of acetone to 50 pct. by volume (tissue H_2O inclusive)

ACTIVE — INACTIVE

EXTRACT I — RESIDUE

strongly concentrated

CONCENTRATE (II)
filtered

FILTRATE (III)
freed from protein—different methods used: precipitation by metal sols or gentle heat coagulation with the addition of acid

PROTEIN-FREE FILTRATE (IV) (PERNAMI I)
free from albumin but not from salts. 3-4 gm. dry matter from original 100 gm. liver shaken with phenol—this extract, (IV) gives off the active substance quantitatively to phenol along with other substances. Add ether and H_2O to the phenol solution—the antianemic substance can be quantatively shaken into the water layer

FRACTION VI (Clinically very potent (HEPTOMIN—I—dark)

0·27 gm. dry matter from 100 gm. liver
Treat with active "coal" (charcoal)

COAL ADSORBATE — FILTRATE

extracted by phenol and regenerated by shaking with ether and H_2O

FRACTION VIII (Fully active)
0·028 gm. dry matter from 100 gm. liver combined the phenol extraction with extraction with H_2O containing phenol

FRACTION B — FRACTION A

0·001 gm. dry matter from 100 gm. liver additional adsorption on active charcoal and combined extraction with phenol water

(Fraction A:) 0·019 gm. dry substance from 100 gm. liver (inactive)

FRACTION BB
0·001 gm. dry matter from 100 gm. liver evaporated to dryness, dissolved in glacial acetic acid and precipitated with excess ether

FRACTION BBa
(nearly colorless)
0·001 gm. dry substance from 100 gm. liver

Laland and Klem.[75] Further purification was achieved by employing phenol and methyl alcohol for fractionation. 50 and 75 mg. of this purified preparation gave satisfactory results. By these methods Ungley purified Dakin and West's Anahaemin at least two and one half times.

In 1936 Wilkinson[86] applied Reinecke acid precipitation as employed by Dakin and West to the preparation of active liver extract[84, 85, 86, 47]; he was able to elicit maximal response with total doses of 18 to 36 mg. equivalent to 661 to 1332 grams of fresh liver.

WORK OF SUBBA ROW, JACOBSON AND ASSOCIATES—THE MULTIPLE FACTOR HYPOTHESIS

The investigators whose work we have so far considered have worked on the general hypothesis that the active portion of liver is a single chemical entity. The fact that

the reports of the chemical properties of their active preparations differed might lead to some doubt that a single substance is involved. The possibility exists that the activity of material effective in the treatment of pernicious anemia rests upon a certain type of compound or linkage common to more than one substance as is believed to be the case of some of the vitamins. Then again, one cannot neglect the consideration that successful therapy may depend upon the interaction of several factors.

In 1935 Fiske, Subba Row and Jacobson presented results which suggested that therapy in pernicious anemia could be achieved most successfully by a combination of two or more substances.[22,68] This led to the development of a multiple factor hypothesis. A report by Jacobson and Subba Row in 1937[41] indicated that there is (*a*) a primary, active hematopoietic factor in liver, and (*b*) at least three accessory factors, in themselves inactive, but whose presence materially augments the activity of the primary substance. They observed that continued purification of active liver extract, in the absence of significant losses and of destructive procedures, led to a partial or complete loss of therapeutic activity, but that combining these purified preparations of reduced potency with certain inactive fractions, resulted in the restoration of activity.

The four factors believed to be concerned are:

A. The primary factor of unknown chemical nature active in amounts of 0·2 to 0·4 mg. per day.

B. Three accessory factors: Inactive, singularly or in combination
   (1) Fraction A—*l*-tyrosine[68]
   (2) Fraction C—probably a complex purine[68]
   (3) Fraction F—probably a peptide.[70]

Fraction C (11 mg. from 100 grams of fresh liver) consisted of light yellow crystals showing positive xanthine, murexide and diazo tests and containing 33·1 per cent. nitrogen. The tentative conclusion was drawn that the substance is a complex purine resembling members of the pterine series of Wieland and Schöpf. Later work by Subba Row indicates that fraction C is composed, for the most part, of xanthine, accompanied by several other difficultly separable substances.

In 1936, Subba Row and associates[69] reported the preparation of an active product by the elution with 65 per cent. ethyl alcohol after adsorption on charcoal—a method which they had already used in the isolation of fraction C[68] and one which is quite similar to that developed by Kyer at about the same time.[51] A summary of the method of purification employed by Subba Row *et al.* is given in Table V.

Fraction I, a white microcrystalline material, had a negative biuret, Mellon's and Sagakuchi's tests; its absorption spectrum showed an inflection between 2480 and 2560 Å (note similarity to absorption spectrum of material of Laland and Klem). Fraction I proved effective clinically in total amounts of 4–8 mg. administered over a 10-day period.

In 1938, these investigators could report that by further purification the yield of total solids in the primary factor had been reduced to 1·2 mg. from 100 grams of liver, however with diminished potency.[71] There was evidence that the diminished potency was due to the absence of additional accessory factors. Two such materials were isolated from the mother fraction of the primary factor and identified as tryptophane and guanosine. All five accessory factors together, but without primary factor, were inert in a pernicious anemia case. Yet administration of the five accessory factors along with the primary factor (in dosage of 0·12–0·26 mg. per day) proved active; of eight cases four responded maximally.[71,42]

Further purification of the primary factor by readsorption on charcoal, elution and then precipitation by a mixture of alcohol and ether yielded an amorphous material which when tested on one patient showed good activity in dosage of 0·06 mg. per day. Chemical properties of the primary factor suggested that it is a complex pyridine derivative; in support of this view, synthetic nicotinic acid administered parenterally in dosage of 1 to 2 mg. per day to two patients along with three accessory factors (A, C and F) effected moderate hematopoietic response and clinical improvement.

Other Evidence for More Than One Factor

Eisler, Hammarsten and Theorell,[17] using cataphoresis, obtained evidence of two active principles in liver preparations—one of which leads to reticulocytosis and the other,

TABLE Va

150 c.c. *Commercial Liver Extract* (equivalent to Cohn's G)
(3 c.c. from 100 gm. fresh liver)
Dissolved in 1 liter H_2O
Brought to pH 8 with NaOH, acidified to pH 6 with HCl
Added 50 grams norite and stirred 1 hour
Filtered

Charcoal + Adsorbate
Washed repeatedly with H_2O till washings colorless.
Suspended in 1 liter 65 per cent. ethyl alcohol, brought to the boiling point, stirred 5 minutes and filtered hot
Elution repeated

Combined Eluates
concentrated under diminished pressure at 40° C. to 150 c.c.

Fraction B
concentrated further under reduced pressure

White Granular Material crystallized → Fraction C

Filtrate—Fraction D

TABLE Vb—I

Fraction D
(150 c.c. from 5 kg. liver)
(10-12 mg. total N per 100 gm. liver)
Acidified to pH 2 with HCl
Added 16 gm. fuller's earth
Stirred mechanically for 30 min. at room temp.
The ppt. was filtered and washed once with 50 c.c. H_2O

Filtrate + Washings
Added 10 volumes 95% ethyl alc. and 10 vols. ether
Mixture left in cold room 24-36 hours
Filtered

Precipitate (*Fraction H*)
(20 mg. from 100 mg. of liver—12-13% N)
Dissolved in 50 c.c. H_2O
Brought to pH 3 with 10 N H_2SO_4
Caused a crystalline ppt. to settle, mainly of $CaSO_4$

Filtrate
Added to 40 c.c. H_2O containing 1 gm. Reinecke salt at 40°
In cold room for 24 hours—brought down a crystalline precipitate
Filtered

Precipitate
Washed once with 50 c.c. ice cold H_2O
Suspended in 300 c.c. 0·03 N H_2SO_4 at 30-35°
The Reinecke acid was removed by repeated extraction with a 500 c.c. mixture of equal vols. of amyl alcohol and ether

Concentrated in vacuo to a volume of 25 c.c.

Concentrate
Added 10 vols. acetone and 10 vols. ether
In cold room 48 hours

Precipitate (*Fraction I*)
(Yield of 100 mg.—*i.e.*, 2 mg. from 100 gm. fresh liver)

TABLE Vb—II

Fraction D (1 liter)
Added 7 liters 95% ethyl alcohol
At room temp. 5 hours
Filtered

Filtrate
Added 3 liters ethyl alc. and 10 liters ether
In cold room 48 hours

Precipitate (*Fraction E*)
Dissolved in 500 c.c. H_2O
Added 200 c.c. 5% solution of rhodanilic acid in methyl alcohol
In cold room 48 hours
Filtered

Crystalline Precipitate
Freed of rhodanilic acid by pyridine with subsequent removal of pyridine by ether

Regenerated Rhodanilate Solution
Precipitated by Reinecke salt
Reineckate regenerated (as in other method)

Fraction I
(Yield about the same as in other method)

when administered with the first, to erythropoiesis as well. Hofer in 1934[36] separated a "reticulocyte response" factor from a general "curative" factor.

On the Importance of Tryptophane and Histidine

From the peptide character of the active material of Dakin and West, and of fraction F of Subba Row and associates as well as their evidence for the importance of tyrosine and tryptophane, and from the observations of Laland and Klem that amino acids are among the products of hydrolysis, it would appear that amino acids are of importance in the problem of pernicious anemia therapy. The use of tryptophane in the treatment of anemia (experimental) is first credited to Hirazawa.[34] In the early 1930's, Fontes and Thivolle presented evidence in favour of the hematopoietic action of both tryptophane and histidine.[24–32] They regarded the former as the precursor of the tetrapyrrole group of hæmatin and the latter as the amino acid essential for the formation of globin in the hemoglobin molecule. They first showed the hematogenic action of tryptophane and histidine by their observation that subcutaneous injection into normal rabbits and dogs resulted in "hyperhemoglobinemia" and "hypererythrocytosis"; this action seemed to depend upon the presence of indol and imidazol nuclei and not to be a function of amino acids in general. Alcock in 1933[1] could not produce anemia in experimental animals by tryptophane deficiency alone and was thus led to doubt that the pyrrole of hæmatin is derived from tryptophane. In 1936 Hamada[33] confirmed the results of Fontes and Thivolle by producing an anemia in rats on a tryptophane-poor diet. Levi has reported that the injection of tryptophane in rabbits with experimentally produced anemia caused a restoration of the red cells and hæmoglobin to nearly normal values.[54]

Fontes and Thivolle reported results from the administration of histidine and tryptophane to pernicious anemia patients. They believed that the digestive disturbances in pernicious anemia may interfere with protein breakdown. Their treatment of six cases[29] with parenteral administration of 200–400 mg. histidine and 100–200 mg. tryptophane for a month was followed by a rapid remission of long duration in one case, a slow remission in another, a rapid remission followed by relapse in the third, and complete inactivity in the other three cases—not an impressive record in a disease which may run a course of remissions and relapses as pernicious anemia does.

Fontes and Thivolle have consistently maintained that the activity of raw liver and of the various liver extracts depends entirely on their contact of tryptophane and histidine in the free state. However, Cohn and associates obtained active preparations from which all tryptophane had been removed. Tryptophane and histidine were not found among the amino acids set free on hydrolysis of the material of Dakin and West. Aleksandrowicz and Gabryelski[2] found no tryptophane in a commercial preparation of proved activity (Pernaemon).

Negative results were obtained by Cuthbertson, Fleming and Stevenson,[11] who gave daily injections of 100 mg. tryptophane and 200 mg. histidine to two pernicious anemia patients. Dominici and Penati[16] were also unable to confirm the favourable results of the French investigators. Tochowicz[73] agreed with Fontes and Thivolle that some of the trouble in pernicious anemia lies in faulty protein metabolism; he concluded that although tryptophane may play a role in pernicious anemia, histidine is of no importance in either the pathogenesis or the treatment of the disease.

Here again there are conflicting reports. Tentatively, we may conclude that tryptophane may play a role in the treatment of pernicious anemia, yet by no means a major one. The evidence for the importance of histidine in the "antianemic factor" is even less convincing.

Work of Mazza and Penati

Mazza and Penati[58] have isolated active materials, containing, they believe, a nucleotime, a polypeptide and a pterine. Their steps of fractionation are summarized in Table VI.

Their substance C which they believe is of pterine nature showed maximal absorption at 2535 Å and 2490Å.

Substance D contained 3 per cent. ash (traces of iron and copper); its microanalysis showed 50·1% C, 7·6% H and 12·4% N. It also contained phosphorus (about 3 %) and sulphur (trace). Ninhydrin and Mellon's tests were weakly positive; there were strongly positive tests for histidine and pentose; and a negative test

TABLE VI

Minced pig liver
| Pressed at 500 atmospheres pressure
Liver juice
| Treated with 96% ethyl alcohol to give a 70% alcohol content
| Dilute H_2SO_4 to pH 5
| Boiled for ½ hour

Precipitate (proteins) — Filtrate
Filtrate
| Concentrated in vacuo to a syrup
| Extracted with trichlorethylene

Extract (lipoids) — Syrupy residue
Syrupy residue
Taken up in 80% alcohol

Precipitate — Filtrate
Filtrate
| Neutralized
| Treated with saturated soln. of $CaCl_2$

Precipitate — Filtrate
Filtrate
| Calcium removed by ammonium oxalate

Precipitate — Filtrate
Filtrate
| Solvent removed in vacuo
| Treated with 5 vols. 98% alcohol
| Precipitate dried in vacuo

Substance A
| (500 mg. from 500 gm. fresh liver)
| (active in total dose of 3 grams)
| Put in aqueous solution
| Treated with soln. of basic lead acetate and $Ba(OH)_2$

Filtrate
| Pb and Ba removed by H_2SO_4
| Filtrate to pH 5
| Charcoal adsorption

Charcoal and Adsorbate
Elution with warm (70°) 50% ethyl alcohol at pH 5 (acetic acid)

Eluate
| Alcohol removed in vacuo
| Charcoal adsorption and elution repeated
| Resulting eluate evaporated to dryness

Substance B
(100 mg. from 500 grams liver)
(active in total dose of 0·5-1·0 grams)
(sky blue fluorescence)

4% *Solution Substance B in* H_2O
| Precipitated with H_2SO_4 and phosphotungstic acid

Precipitate
| Decomposed by $Ba(OH)_2$, the Ba being removed by H_2SO_4 solution concentrated to small volume
| Treated with 10 vols. absolute alc. and 10 vols. acetone

Precipitate
| Dissolved in H_2O
| Saturated with $(NH_4)_2SO_4$

Precipitate
| Dissolved in 75% alcohol and reprecipitated with absolute alcohol and acetone
| Precipitate dried

Substance D
(5 mg. from 100 grams liver)

4% *Solution Substance B in* H_2O
| to pH with HCl
| Adsorbed on fuller's earth
| Eluted with 5% pyridine at 70°

Pyridine Extract
| Evaporated to dryness
| Residue dissolved in 1 N NaOH
| Acidified with HCl

Filtrate
| Adsorbed on fuller's earth and eluted with 5% pyridine
| Eluate concentrated in vacuo to small volume
Added NH_4OH, NH_4Cl and $AgNO_3$

Precipitate
| Put in solution with 1N HCl
| Solution adsorbed with fuller's earth which is then eluted with 10% pyridine
| Pyridine eluate evaporated in vacuo to dryness

Substance C
(1 mg. from 5 kg. liver)

for tryptophane. It showed maximal absorption at 2600 Å and 2650 Å. Of the total nitrogen, 5·8% was amino nitrogen; after acid hydrolysis for 1½ hours amino nitrogen accounted for 68·2% of the total nitrogen. They believe that fraction D consists of a combination of an adenine nucleotide and a polypeptide containing proline, oxyproline, histidine, arginine, hydroxyglutamic acid and a monoamino-monocarboxylic amino acid.

Unfortunately, Mazza and Penati have as yet not reported adequate clinical tests for their material. In the single case which they do report for their purest preparations (C & D), substance D given alone (375 mg. over a period of 8 days) showed no activity. Then in the same case both D (total additional dose of 325 mg.) and C (total dose of 13 mg.) given over a two-month period showed only moderate activity, raising the red count from 2·0 million to 3·2 million. From this one case considering the relatively large amount of material used, their substances are most likely not very pure and thus the chemical properties they have described may be those of contaminating compounds rather than of the antianemic factor.

Miscellaneous Contributions

Buchanan in 1929[3] reported that the active principle of liver extracts has apparently every chemical resemblance and physiological action of oxidized glutathione. Although Fleming[23] later declared that glutathione, mostly in oxidized form, enters into the composition of the antianemic factor, Koser in 1936[50] denied the importance of glutathione in this respect.

In 1933 Felix and Fruhwein[21] fractionated active liver extract, following the activity by determining the reticulocyte response after injection in anemia (not necessarily pernicious anemia) patients or normal persons, and by methemoglobin formation *in vitro*. After repeated purification with mercuric sulfate, their preparation gave a negative test for tryptophane, and a negative biuret test. It is unfortunate that their preparations were not adequately assayed on pernicious anemia patients.

In 1935, Erdös[19] reported his work on the preparation of active material. He made an acid extract of finely hashed liver, the protein then being removed by iron. Inasmuch as his material gave a positive biuret and showed an increase in amino-nitrogen by about 300 per cent. after acid hydrolysis, he believed it to be a peptide. He isolated a water insoluble silver salt from the analysis of which he suggested the formula $C_{650}H_{720}O_{36}N_{30}S_2P_2Ag_3$ with a molecular weight of about 10,000. Unfortunately his method of assay was inadequate; he tested activity on the anemia produced in dogs and rabbits by the administration of phenylhydrazine.[20]

We have thus far discussed the results obtained by investigators who employed the orthodox chemical procedure of isolation and identification. In 1937, Jacobs[37,38,39] reported conclusions regarding the chemical character of the active liver material which he reached by employing less orthodox means. From a study of the properties exhibited by potent liver extracts, he tried to deduce the chemical nature of the antianemic principle. In his first paper[37] he suggested further investigation of the possible role of glucosamine and the common amino acids (especially leucine and tyrosine). By mixing raw potato scrapings source of tyrosinase) and tyrosine he believed he could form the 5, 6-quinone of dihydroindole-2-carboxylic acid, the so-called "red substance" of Raper[65]; feeding such a mixture to a pernicious anemia patient resulted in inconclusive results.[39] Later Jacobs concluded that the "red substance" of Raper was not concerned in the activity of liver extracts. In his most recent paper[40] he proposes to investigate choline for its antianemic effect inasmuch as he was able to isolate this compound from a commercial liver extract. However, we doubt that this substance will show any activity at all; we are of the opinion that the activity of the commercial liver extract was lost for the most part during his repeated decolorizations with animal charcoal.

Aleksandrowicz and Gabryelski[2] have proposed that heparin is one of the important therapeutic factors in liver preparations. Heparin administered intramuscularly to three pernicious anemia patients effected a moderate erythrocyte response in one. On the whole their results, both clinical and chemical, do not present convincing evidence for their thesis.

Jones, Phillips, Larsell and Nokes[44] reported that nuclear extractives from various

organ extractives—supposedly consisting chiefly of nucleoproteins and the sodium salts of nucleic acids—yielded satisfactory results in pernicious as well as other anemias when administered orally.

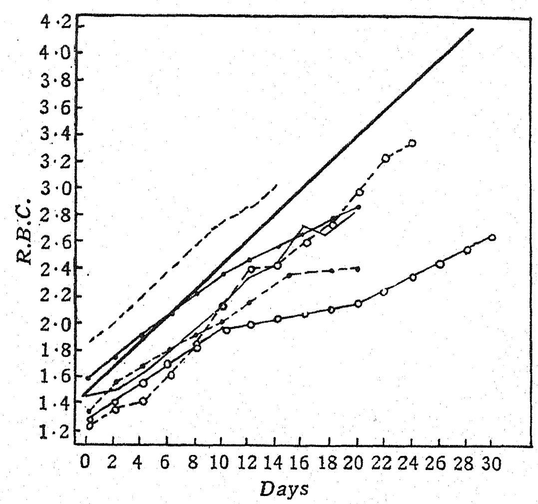
Karrer, Frei and Fritzsche in 1937[45] reported that liver preparations possessing full antianemic potency in a singly administered dose of 10–20 mg. contain amounts of phosphorus, pentose and adenine consistent with the presence of an adenin-nucleotide. However, a purer preparation active in doses of 8 to 10 mg.[46] contained no phosphorus or pentose. The ninhydrin test was positive, before and after hydrolysis, but the biuret was negative or at best only weakly positive. No polypeptides of the usual type were present. After hydrolysis, 2-amino acids were present only in small quantities, if at all. Koller[49] reported on the clinical use of Karrer's material.

In a short note in 1939, Tschesche and Wolf described the properties of an active material that resembled the preparation of Karrer *et al.* in that it showed a negative or only slightly positive biuret test, but a positive ninhydrine both before and after hydrolysis.[74] Their material, a white powder active in a dose of 40 mg., also had a negative Molisch and a negative Millon test; it was free of flavine, purine, pterine, reducing sugar and phosphoric acid esters. It analyzed: C, 50%; H, 7%; N, 14·5%; S, 0·6%. They have not as yet reported their clinical results in any detail.

Comparison of Activities of Preparations

In the foregoing sections, the methods of preparation and, in some cases, the properties of various antianemic preparations have been described. There is as yet no agreement among the different investigators regarding what is the active material, or what are its properties. It may be of some interest, however, to compare the relative activities of some of the better preparations. How should such a comparison be made? The phenomenon of reticulocyte response is of little value in determining the comparative efficiency of extracts. It may or may not give an indication of the presence of potency, and it does not appear to indicate the degree of potency. Murphy suggests[63] that perhaps the most critical and important means of comparison is the determination of the amount of antianemic material that is necessary to maintain the erythrocyte count of a pernicious anemia patient at a normal level. Inasmuch as there are few reports available concerning the long-time maintenance requirements of the extracts in which we are interested we cannot make our comparisons on this ideal basis.

In the absence of a more satisfactory basis of comparison, a few of the preparations may be compared in terms of the erythrocyte response elicited by definite quantities of different products (Chart 1, from *J.A.M.A.*, 1941, 116, 367).



——	Murphy-Hart fall	20·0 MGM.
•—•—•	Ungley, Davidson and Wayne	8·9
•- - -•	Dakin, Ungley and West	4·5
o—o—o	Ungley	3·4
o— —o	Jacobson and Subba Row 1937	2·2
——	Koller	1·9
- - - -	Jacobson and Subba Row 1940	0·7

Chart 1.—Average erythrocyte regeneration curves following the administration of various purified liver extracts. The calculated average daily amount of material administered is recorded in the legend. The sources of these data are contained in the text. (The daily doses recorded for the curves of Jacobson and Subba Row refer only to the amount of primary factor administered; in addition, three accessory factors were administered in the 1937 curve, in a daily amount of 3·4 mg. and five accessory factors were administered in the 1940 curve in a daily amount of 6·2 mg.)

The data have been presented in the hope that further advances in the understanding of the chemical nature of the substances concerned will enable us to explain the discrepancies in the magnitudes of response achieved by different investigators. It is,

TABLE VII

Comparison of reported properties of certain liver extracts containing primary anti-pernicious anemia factors

	Cohn *et al.*	Dakin *et al.*	Laland *et al.*	Subba Row *et al.*	Karrer *et al.*
PHYSICAL PROPERTIES					
Color	....	....	Reddish Yellow	Colorless	....
Solubility	Sol in H_2O ,, ,, Acetic acid ,, ,, Phenol ,, ,, Formamide ,, ,, Glycerol ,, ,, 70% Alcohol Slightly sol. in 95% Alcohol Insol. in Abs. Alc. ,, ,, Ether ,, ,, Acetone	Insol. in Absolute Alcohol	Insol. in ether Sol. in H_2O Partly soluble in alcohol		....
Insoluble Salts with	Phosphotungstic Acid Tannic Acid Sulfuric Acid Picric Acid Gold Chloride Platinic Chloride Silver Nitrate	Pptd. by High Conc. of Trichloracetic acid but not by Low. Not pptd. by Rufianic Acid. Not pptd. by Ferro-cyanic Acid. Not pptd. by Meta-phosphoric Acid.	Phosphotungstic Acid Heavy Metals		....
Precipitation by $(NH_4)_2SO_4$	....	Precipitated	Partially pptd.	....	....
Dialysis	Dialyzable	Dialyzable	Dialyzable	Dialyzable	....
Specific Rotation	....	$(a)^{16}D$–112° to –133°	....		....
Absorption of Light	....	....	250–265 mu ; 345–350 mu	248–256 mu	....
CHEMICAL CONSTITUTION					
Composition in per cent.					
C	....	46·8 –48·1	53·64	41·56	45·68
H	....	6·6 – 6·8	6·85	6·74	6·75
N	10·8	15·2 –16·8	13·33	13·13	14·63
S	None		0·74	1·2	Present
Ash			2·05	(SO_4 –10·2)	
Molecular Weight	....	2000–5000	....	....	
Presence of Pentose	None	....	Present	Present	None
Biuret Reaction	Negative	Negative	Negative	Negative	Negative
Amino Hydrogen					
Before Hydrolysis	None	0·5		5	
After Hydrolysis		10–10·4	Not Reported	75	Not Reported
Amino Acids Isolated	Not Reported	Arginine, Glycine, Leucine, Aspartic Acid, Hydroxyproline, Proline	Not Reported	Not Reported	Not Reported

unfortunately, apparently not possible at the present time to reconcile the various claims and facts regarding the material or materials which are present or capable of extraction from liver, and which are therapeutically active in pernicious anemia. Table VII summarizes the chemical properties of some of these preparations which we have discussed. Although it is not yet possible to present the nature of the active material with chemical exactness, it is, nevertheless, proper to note with some satisfaction that since whole liver therapy was instituted, the amount of material needed by the patient per day had decreased from 400 grams to less than 10 mg. So much

progress makes it reasonable to expect the isolation of the active material in the near future.

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CANCER RESEARCH IN INDIA

BY

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THERE is probably no other disease or group of diseases regarding which there are so many misconceptions in the minds of the medical and general public as cancer. It may therefore be useful to state some general ideas regarding the nature of cancer, which have evolved as a result of clinical observation and experimental investigation during the last 30 years before dealing with cancer research in India.

Cancer is the expression of a universal cell property and includes a great group of diseases which differ widely from one another in origin, clinical course and morphological appearances. This conception that cancer is not a single disease, but a generic term covering a broad field of biological science is now accepted by all who have studied this problem carefully. If this conception is correct it follows that one should not look for similar course in the evolution of different types of cancer, nor is it profitable to look for one single cause or one particular type of treatment for the various types of malignant disease. One might therefore neglect as unreasonable the constantly recurring announcements in the general press of the so-called discoveries of the cause of cancer as well as its cure and which always receive warm but short-lived reception from men of large means but small understanding.

If the view that unrestrained and malignant proliferation is a property inherent in all cells is acceptable then it follows that every cell should be capable of such proliferation under certain specific conditions. A good deal of clinical and laboratory evidence has now accumulated which supports such a view and it has been found that so far as human subjects are concerned no cell type is exempt from a neoplastic growth. Careful observation has shown that all races of men who have been studied are liable to cancerous growth in one form or another. It has further been observed that malignant tumours occur in most members of the vertebrate species and that even insects are not exempt from it. The same variety of predisposing, contributory and exciting factors and the same general biological properties are revealed in lower animals as in man. This property of unrestrained growth is evidently more marked in certain types of cells, *e.g.*, embryonal cells. The cells in atrophic or vestigeal organs are also prone to an unrestricted autonomous growth. It is known that this property is influenced by heredity, and that the suppressed growth of cells in adult life is liable to be released from restraints by certain external influences or agents, such as injuries, inflammations and radiations. Modern studies conducted by the use of cancer producing chemicals have shown that conditions which obtain in healing wounds favour the appearance at the site of injury of progressively growing tumours. In some experimental animals it has been found that the occurrence of breast cancer usually depends upon the working of three separate factors operating at the same time. (1) A hereditary factor, or susceptibility. (2) A factor transmitted in the milk of animals with a tendency to cancer production. (3) A hormone related to pregnancy.

It is a noticeable fact that interest in research on cancer has been almost completely neglected in this country both by members of the medical profession and by workers in basic sciences like Biology, Physics and Chemistry. And yet one cannot conceive of any other field of study in human disease which affords such wide scope for investigators in these sciences. This lack of interest may be attributable to several reasons.

Firstly, an impression has been fostered in the minds of the public, by people who have not spent much time or thought on this matter that once a person is declared to be suffering from cancer, his case is hopeless and nothing much could be done to get him over his ailment. I remember reading a paper many years ago before medical men assembled from all parts of

this country, on the incidence of different types of cancer in patients who presented themselves in one of the hospitals in Bombay. The audience was impressed but baffled and could not understand that any one should waste his time on collecting information of this type. Their feelings were expressed by one of the members who rose to ask a question at the end of the paper. He wanted to know the use of all that had been said unless he could be told as well how to cure cancer. One did not know then and one does not know now of a cure for all cancer, but a great deal is known about the treatment of different types of cancer and a cure by rigid standards can be demonstrated in a large number of cases.

The second reason is that in most of the countries which have a poorly developed health organisation, and a health consciousness in the masses of people is almost lacking, the infectious diseases like cholera, plague, typhoid, small-pox, parasitic diseases like malaria, kala-azar, amœbiasis, and nutritional deficiency diseases overshadow the picture of diseases in the country to such an extent that cancer does not occupy an important place in the minds of medical profession. This does not mean that cancer is less frequent here than in other countries. Hardly twenty years ago it was a current belief among many people that cancer was a disease of civilisation meaning European civilisation and it was therefore argued that uncivilised or non-European countries should have hardly any cancer. There was no justification for this belief except for the fact that in economically rich countries the successful control of infectious and parasitic diseases increases the normal expectation of life and many more people live long enough to suffer from diseases peculiar to middle and old age. In economically poor countries like India a large bulk of people do not live long enough to show the manifestations of cancer which are mainly noticeable in the fourth decade of life and even later.

The third reason is probably an inadequate training of members of medical profession regarding the basic facts of cancer. A significant change has however taken place in the attitude of the medical profession towards malignant diseases, inasmuch as there is a growing recognition of the deficiencies of the medical knowledge about cancer and its treatment. It has been realised that effective study and treatment of cancer may no longer be considered the occasional task of the general practitioner or surgeon, but constitutes a highly complex medical speciality. It may safely be said that cancer is now owned to be one of the most important and most progressive departments of medicine, as it is also the most fundamental problem of biology.

Cancer research, like most medical research, follows three main directions. At first a disease is noticed and clinical observers study its manifestations, its points of resemblance and the characteristic differences which distinguish it from other similar conditions. Thus by careful continued observation a lot of useful information is collected which supplies the basis for diagnosis, and treatment of a clearly delimited disease entity. So far as cancer is concerned medical men have observed its manifestations in human beings for many centuries and attempts have been made to limit its ravages by salves, ointments and internal medications with very doubtful efficacy. It is only during the last forty years that important information has begun to accumulate as a result of a careful record of all the signs, symptoms and complications, along with a careful microscopical study of tumours, and a long follow-up of cases extending over five and ten-year periods. Such work is laborious and is unattended by any spectacular results in a short time. It can only be undertaken in properly organised institutions. In many institutions in Europe and America it has yielded a rich harvest of knowledge which has revolutionised our ideas regarding the nature and treatment of malignant disease. To cite only one example many types of cancer which were considered hopeless at the commencement of this century are now successfully treated at the New York Memorial Hospital and large numbers of people are saved from the slow but relentless ravages of a dread disease. In this country cancer has been treated more or less efficiently in most of the big medical institutions; however the system of records and follow-up is so woefully defective in the majority of places that no useful contribution has been made to the sum of our knowledge, in spite of the skill of our surgeons and the scientific attainments of

our physicists and radiologists. Isolated observations have been recorded in some medical journals which relate mainly to the unusual types of malignant disease. A newer consciousness is dawning among the younger medical men and it is hoped that a spirit of conscientious team work which is gradually developing will replace a statement of vague impressions by an accurate description of personal observations. So far as the non-medical public is concerned it may be stated that all careful observation has shown that cancer is not incurable, and that in early stages presents a much more hopeful outlook than some other diseases which hold no dread to the public such as diabetes, heart disease and nephritis.

It may not be out of place to say a few words about the so-called cancer cures which are extensively advertised by the press and the credulous public from time to time. Malignant disease is difficult to detect in its early stages without long and adequate training and a systematic study. On the other hand many cases which are diagnosed as cancer are probably inflammatory in nature and improve with ordinary care and treatment. It is possible to relieve the acute discomfort and reduce the swelling attending cancer by several methods without eradicating the disease. In such cases though the disease is advertised as cured, it recurs after a lapse of months or years and may lead to a fatal termination by its appearance in some other organ in the body. The danger to the public lies in the fact that the patients in their attempt to follow some plausible treatment deprive themselves of the opportunity of being effectively treated at a stage when a radical cure could be expected by modern methods.

The second approach to the problem of cancer is by a statistical investigation of the cancer morbidity and mortality in any particular country over a stated period of time. Until as recently as the commencement of this century knowledge was so slight and contemporary statistics so inadequate, that dogmatic statements were made and believed by people who were guided by feelings and impressions. One of the first points, therefore, which had to be cleared, was to determine whether any race of man is really immune from neoplastic disease, as had been confidently asserted. The immediate importance of the inquiry lay largely in the possibility that by this means information could be obtained pointing to significant effects on cancer incidence of environment, diet, social conditions or racial character. Such investigations have produced valuable results in countries where the vital statistics are accurately maintained and where the economic conditions permit every citizen to obtain medical relief either from individual medical practitioners or from private or public medical institutions. Such information has allowed a study of particular types of malignant diseases being associated with certain occupations or certain social habits. It has further been found that certain types of cancer are more prevalent in certain regions and much less common in neighbouring areas where the habits or economic condition of inhabitants are not very different. These differences in the frequency and types of malignant disease have stimulated investigation into their causes and have in many cases been fruitful in results. The frequency of cancer of the lip in luminous dial painters, the cancer of the skin in chimney sweepers and the cancer of lung in miners in Czecho-Slovakia are a few instances of this type. In our country statistical investigations are handicapped by several factors. The certification of a large number of deaths by non-medical men, the lack of adequate medical facilities except in larger towns, the easy credulity of many educated and most ignorant people are factors which make the work of public health administrators well-nigh impossible. However, in spite of these drawbacks several interesting observations have been forthcoming which deserve further study. The frequency of Kangri cancer of the skin of the abdomen in Kashmir described by Neve,[1] the cancer of the cheek in betelnut chewers on the south-west coast of India described by Orr,[2] and the cancer of external genitalia in the Hindu males are conditions which deserve careful study. A valuable preliminary statistical study was undertaken by Vishwanath and his colleagues[3] from Lahore on the basis of hospital records in the big medical institutions in this country. This is the only instance of an investigation on cancer in this country which was assisted

by a grant from the Indian Research Fund Association.

The third method of approach to the cancer problem is by laboratory experimental method. This method was delayed because of the great difficulty experienced by early workers in transmitting malignant disease to experimental animals or in producing cancer by external applications. A new era of cancer research was initiated by the work of Yamagiwa[4] and his pupils after production of cancer of the skin in rabbits by applications of tar in 1914. Since that time an enormous amount of work has been done on experimental transmission of cancer in animals, the histological changes in the skin by application of carcinogenic substances, and as a result of exposure to X-rays and gamma radiations, the chemistry and synthesis of carcinogens, the production of mammary cancer in mice by administration of hormones. The Rockefeller Institute has been working on the question of viruses in the production of certain types of cancer in animals, and the work of Rous and Murphy has thrown much light on this difficult problem. The question of heredity in cancer has been studied by Slyle in Chicago, Little at Bar Harbour and Lynch in New York. The experimental work has assumed such proportions that it has become impossible for one person to keep acquainted with all its phases. There is still a tendency to ignore the fact that experimental cancer research like most other branches of scientific endeavour has made remarkable progress especially during recent years and it seems that great possibilities for further work have been opened up which will elucidate the nature of the cancerous process in the near future. In this country experimental research on cancer has not been touched upon until quite recently and it is expected that with the facilities available at institutions like the Tata Memorial Hospital, the contribution of India in this research will not be negligible. Already some interesting work on the relation of certain enzymes to cancer susceptibility has been carried out and the study of extrinsic factors in production of cancer is engaging the attention of workers. After the termination of the present unsettled conditions this work will gain impetus and many young men will be coming forward to tackle fundamental problems on cancer research from different angles of approach. It is not unreasonable to hope that research foundations and public endowments will give adequate assistance to young men who have the necessary training to undertake investigations at recognised institutions on cancer problem. It need not be emphasised that without such assistance original work on cancer will be impossible in this country and we shall continue to wait as passive spectators in the memorable march of scientific progress.

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INDIAN INSTITUTE OF SCIENCE

THE Government of Mysore have made a capital grant of Rs. 1 lakh and a recurring annual grant of Rs. 15,000, for the institution of æronautical and automobile engineering sections at the Institute.

The President of the *Hindustan Aircraft Construction Co., Ltd.*, has offered a scholarship of $3,000 a year, for four years, to a student of the Institute, tenable at an American institution, for higher studies in Aeronautical Engineering.

—(By courtesy of the Editor, *Journal of Scientific and Industrial Research.*)

LETTERS TO THE EDITOR

A CONSIDERATION OF THE SUCCESSIONAL THEORY OF TEETH

When I first disputed (1938) the oft-repeated statement that the hinder teeth of sharks were there for replacement I was referred to William Andre's report of an injured jaw of the "tiger" shark. An illustration of this appeared in an article Dr. E. W. Gudger kindly sent me but this I regarded as convincing proof that the abnormal teeth there described were due, not to any progression of the gum after the injury, but to disturbance of the dental germs at the injured site.

A photographic illustration of erosion in a marine rock remarkably resembled what sometimes is seen in sharks and rays. Although the former was rightly attributed to depression which allowed accumulation of rain and subsequent erosion of the rock, without question of revolving of the surface, attempts are made to explain what occurs in the jaw of sharks and rays to constant forward movement of the covering of the jaw-cartilage for replacement of teeth which are supposed to be constantly shed.

Examination of sharks at various stages of growth failed to reveal evidence of shedding except for an occasional exposed tooth, whilst minute teeth at the foremost position of the teeth of some sharks rendered very remote the possibility of their being replaced by the stouter hinder ones. Nor did it seem likely that the hindermost poorly developed teeth would ever move forward to replace those stout but seldom used teeth which are usually covered by gum unless this is torn away.

As such replacement by forward progression is quite impossible in some sharks, such as the Devil Ray, it seemed a mistake to conceive some means of replacement other than that of vertical succession and, for want of experimental proof, investigations were made to discover whether any other animals than sharks could replace their teeth in any way but by vertical succession.

Embryonic and adult skates and rays revealed evidence to show that forward progression of the tooth-bearing area was very unlikely to occur, the gum being closely attached to the underlying cartilage and the flattening of the front teeth being constant throughout life, and unrelated to wear and tear.

No species of fish showed revolving of the tooth-bearing area, vertical succession being

demonstrated by X-ray examination and by dissection of the jaw. Thus stout rounded teeth of one row would never move into the position of a sharp tooth of another row when the latter was lost.

Lizards similarly showed vertical succession of their teeth where such replacement was possible and minute teeth lying loose in the gum appeared to correspond to the hinder teeth of fishes and the little loose teeth of Pythons, being rather for reinforcement than for replacement.

Replacement of the solid teeth of snakes did not seem to occur. Careful observation failed to reveal new tooth formation at the base of a tooth and there seemed to be a constant number of teeth in each row of a fully developed example of each species.

Possible replacement of the hollow-teeth of back-fanged snakes appeared to be impossible, for there seemed to be no provision made for revolving forward of undeveloped fangs and the loss of a fang behind a row of solid teeth must be infrequent.

The only position in which it seemed possible to apply the successional theory was in that of the grooved teeth of the front-fanged snakes, where serial development also lent support to the belief that a lost fang might be replaced.

However, occasional ancylosis of an extra fang is not necessarily connected with replacement and it was impossible to conceive how reserve fangs could move into such a position as to emit poison from the only duct of a poison-gland, once a function fang was lost.

These studies indicate that replacement of teeth under natural conditions occurs only by vertical succession, and that the successional theory, involving a constant forward movement of the tooth-bearing area, is founded on assumptions for which there is no justification.

F. GORDON CAWSTON.

West Street,
Durban, S. Africa,
July 7, 1942.

ARC LINES OF COPPER IN FLAME SPECTRA

EDER AND VALENTA who were the first to investigate such spectra, have reported the presence of the following lines amongst others of copper: line λ 4651 A. in the Bunsen flame and lines λ 4275 A. and λ 4355 A. in the oxycoal-gas flame. All these lines involve negative energy levels in the copper atom. The lines λ 4651 A. and λ 4275 A. have the energy level $(-95\cdot2$ cm.$^{-1})$ $3d^9 4s(^3D)\ 5s^4D_{7/2}$, as their initial level. The line λ 4355 A. similarly involves the negative energy level $(-2951$ cm.$^{-1})$ $3d^9 4s(^3D)\ 5s^2D_{5/2}$. The existence of these lines, if real, would point to the availability of an amount of energy of the order of about 7·7 e.v. (7·68 i.p. of cu + 95 cm.$^{-1}$) in the Bunsen flame and 8·04 e.v. in the oxycoal-gas flame. The possibility of obtaining copper atoms in a state higher than its first ionisation potential in the Bunsen flame was thought to be rather remarkable. In our previous note we also have noted the presence of the line λ 4651 A. on our plates. Since that note was published, however, spectra have been taken with an instrument of higher dispersion and resolution. These show very clearly that the line does not belong to the copper atom at all but is one of the strong structure lines or possibly a condensation of many such lines near the head of the (0-1) CuH band at λ 4650 A., whose head is at λ 4648·5 A. and whose origin is at λ 4661·8 A. Fig. 1, which is a contact print of

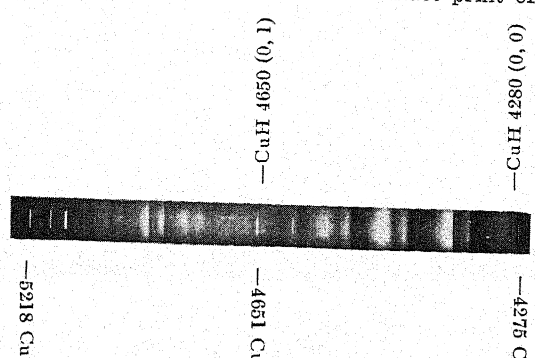

FIG. 1

the copper-chloride flame spectrum (inscribed in which is the copper arc spectrum) taken on

the three prism glass spectrograph shows this very clearly. The wave-length of the copper line itself being λ 4651·1 A., the mistakes in the earlier literature are understandable. We have not repeated the experiments with the oxycoal-gas flame but it seems likely that the lines at λ 4275 A. and λ 4355 A., given by Eder and Valenta are also probably structure lines of the CuH band (0,0) at · 4280 A. and of the bands (1,1) or (2,2) respectively. There does not seem, therefore, to be any experimental evidence for the existence of negative energy levels of copper atom in flames fed with copper salts.

NAND LAL SINGH.

B|1, University Quarters,
Benares Hindu University,
Benares,
July 7, 1942.

1 *Proc. Ind. Sc. Congress*, 1941, p. 31.
2 *Atlas Typischer Spektren*, Eder and Valenta, Wien, 1911.
3 *Atomic Energy States*, Bacher and Goudsmit, 1932.
4 *Report on Molecular Spectra*, etc., Jevons, 1932.

ACCUMULATION OF PYRUVIC ACID IN RICE MOTH LARVÆ (*CORCYRA CEPHALONICA* STAINT) FED ON A VITAMIN B_1 DEFICIENT DIET

WHEN experimental animals like the rat or the pigeon are kept on a vitamin B_1 deficient diet, there occurs in the blood a marked accumulation of carbonyl compounds, chiefly pyruvic acid.[1,2] This characteristic change has also been observed in the blood, urine and cerebrospinal fluid of persons suffering from beriberi.[3] In all these cases, administration of a suitable amount of vitamin B_1 brings about a rapid fall in the pyruvic acid content of the blood to the normal level.

In view of these observations, it was of interest to discover whether the larvæ of the common rice moth (*Corcyra cephalonica* Staint), for whose normal growth vitamin B_1 has been found indispensable,[4] show similar biochemical reactions. The larvæ, after being grown on whole wheat for 15 days, were transferred to a diet deficient in vitamin B_1. They were kept in an incubator at a temperature of 30° C. and a humidity of 75 per cent. They were weighed every week. It was found that the larvæ continued to grow for the first 15 days after which a falling off occurred in the growth rate. After 35 days, the pyruvic acid content of these insects was determined by Lu's method.[5] For comparison the pyruvic acid content of larvæ fed on whole wheat was determined. The effect on pyruvic acid content of transferring larvæ fed for 35 days on a vitamin B_1 deficient diet to a diet containing 5 microgrammes of vitamin B_1 per gramme, was also investigated.

The results are given in the table. For comparison, the blood pyruvic acid values in normal and B_1 deficient rats, pigeons and human beings are included.

	Pyruvic acid	Author
1. Larvæ on whole wheat	18·5–20·5 mg./100 g. dry wt.	
2. ,, B_1 deficient diet for 35 days	164·3 ,, ,,	
3. Larvæ from (2) transferred to a diet containing 5γ B_1 per g. for 66 hrs.	88·25 ,, ,,	
4. Pigeon, normal	0·84 mg./100 c.c. blood	Thomson and Johnson
,, deficient	5·85 ,, ,,	Thomson and Johnson
5. Rat, normal	0·96 ,, ,,	Li and Kato
,, deficient	5·62 ,, ,,	Li and Kato
6. Human, normal	0·56 ,, ,,	Lu
,, deficient	2·35 ,, ,,	Lu

It will be seen that the larvæ, like man and the laboratory animals mentioned, accumulate pyruvic acid when fed on a vitamin B_1 deficient diet. The amount of pyruvic acid present was reduced by nearly 50 per cent. in 66 hours on the inclusion of vitamin B_1 in the diet. The amount of pyruvic acid in the larvæ, both in the normal and deficient state, is much larger than that present in the blood of either man, rat, or pigeon. This, together with the ease with which the larvæ can be handled and the rapid reproducibility of results, suggests the possibility of devising a quick and sensitive method for the estimation of minute quantities of vitamin B_1, such as might be present in blood and other biological materials. The method might be of value in assessing partial degrees of avitaminosis in man. Work along these lines is now in progress.

P. S. SARMA.
KAMALA BHAGVAT.
Nutrition Research Laboratories,
Indian Research Fund Association,
Coonoor,
August 4, 1942.

1 Thomson and Johnson, *Biochem. Jour.*, 1935, **29**, 694.
2 Li and Kato, *Jour. Lab. Clin. Med.*, 1940, **26**, 1314.
3 Platt and Lu, *Quart. Jour. Med.*, 1936, **29**, 355.
4 Swamy and Sreenivasaya, *Curr. Sci.*, 1940, **9**, 493.
5 Lu, *Biochem. Jour.*, 1939, **33**, 249.

STUDIES IN INSECT NUTRITION: BIOLOGICAL ASSAY OF THIAMIN WITH *CORCYRA CEPHALONICA* STAINT AS THE EXPERIMENTAL ANIMAL

THE rice moth larvæ were fed *en masse* in batches of 25 on two diets—thiamin and thiamin-free—yeast being employed as the source of the vitamin. Thiamin-free yeast was obtained by autoclaving brewery yeast at 30 lbs. for 3 hours. Batches of 10 larvæ picked out at random from the culture dishes, were weighed after known intervals.

The results (Table I) reveal that autoclaving destroys a thermolabile growth factor, manifestly essential to the insect. This factor was suspected to be closely allied to, if not identical with, thiamin.

TABLE I

Diet	Weights of ten insects in mgm. after known intervals in days		
	15	25	35
Thiamin-free	1·16	1·21	3·40
Thiamin	3·74	29·50	166·00

With a view to elucidate this point, feeding experiments were conducted with thiamin-free diet (autoclaved yeast) to which known amounts of synthetic thiamin were added. Results are given in Table II.

TABLE II

Diet	Weights of ten insects in mgm. after known intervals in days						
	15	20	30	40	45	63	70
B_1 (active yeast)	2·89	7·0	51·67	205·5	236·5	..	..
B_1-free (autoclaved yeast)	1·9	2·0	2·15	..	..	..	..
Do. + 1·44 I.U. per gm. of diet ..	1·16	..	2·75	7·0	..	43·33	82·5
Do. + 2·88 I.U. per gm. of diet ..	1·45	1·7	4·5	14·4	16·9	83·33	104·2 (one pupated)
Do. + 5·76 I.U. per gm. of diet ..	2·4	3·5	8·85	28·0	33·5	139·2 (2 pupated)	All pupated

I.U. = International Unit.

It will be observed that from the data (Table II) that when the diet is supplemented with graded doses of thiamin, the insects grow and it is interesting to note that the increases of growth, are strikingly proportional to the amounts of thiamin added. This at once points to the possibility of employing these insects for an assay of thiamin in extracts, physiological fluids and foods.

It will also be seen (Table II) that the diet, to which the maximum amount of thiamin is added, does not promote the growth of the insect to the same extent as is achieved by the active yeast diet. This may be due to two causes:—(*a*) either the quantity of thiamin is not sufficient or (*b*) there is some factor other than thiamin, which is either destroyed or rendered unavailable to the insect during the process of autoclaving.

With a view to examine the first possibility, experiments on the supplementation of the vitamin to a thiamin-free diet, in graded amounts covering an extended range, were carried out; the results are given in Table III.

TABLE III

Thiamin per gm. of diet I.U.	0	5	10	15	20	40	Active yeast
Wt. of insects after 23 days in mgm.	High mortality	3·35	6·60	10·0	9·5	9·0	40·5

It will be seen from Table III that fifteen international units of thiamin per gram of diet, saturates the preparation; higher amounts of the vitamin do not induce further growth. But, when the diet is prepared with an equivalent quantity of active yeast, a fourfold increase in growth is obtained. This increase could not be attained by an exclusive addition of thiamin. As indicated, we are led to postulate the existence of another thermo-labile factor, an elucidation of the nature of which, is under active investigation.

P. S. SARMA.
B. G. L. SWAMI.
M. SREENIVASAYA.
Indian Institute of Science,
Bangalore,
July 25, 1942.

COMPARATIVE STUDIES ON THE NUTRITIVE VALUE OF FISH AND PRAWNS MUSCLE

IN Bombay coastal waters, along with different varieties of fish (vertebrates) prawns (invertebrates) also are caught and utilised by the public in abundance. The fish are seasonal in their availability while the prawns are found throughout the year. As the prawns contain a high percentage of protein and form a staple food for the poor class in Bombay and along Konkan coast, it was thought desirable to study the comparative nutritive value of the prawn and fish. Four varieties of fish and four of prawns were undertaken to study their nutritive values. In addition to the determinations of the biological values of the proteins of prawns and fish some of the other constituents, *viz.*, fat, calcium, phosphorus and iron, have been estimated. Biological value was determined according to the method adopted by Mitchell,[1] and Chick *et al.*[2] The amount of fat was determined by extraction of the dried material with ether. The ash was estimated by Stolte's method described by Peters and Vanslyke.[3] Phosphorus was estimated by Brigg's[4] modification of Bell and Doisy method, and calcium by the volumetric permanganate method described by McCrudden,[5] and iron according to Kennedy.[6]

In Table I*a* and I*b* are given the analyses of the fresh fish and prawns and in Table II*a* and II*b* their biological values and digestibility coefficients.

TABLE Ia

Analysis of the fresh fish

Name	Scientific Name	Edible Portion	Contents per 100 grammes of the edible portion							
			Moisture	Protein	Fat	Ash	Calcium	Phosphorus	Iron	Insoluble Inorg. matter
Surmai	Cybium	87·2%	63·0	19·86	1·37	—	92·54	161·75	2·031	—
Ghol	Sciœnea	91·7%	69·7	18·39	0·898	2·37	88·57	153·2	2·059	0·035
Mushi	Scoliodon	94·95%	76·46	14·86	2·860	1·026	58·64	168·86	2·06	0·028
Ravas	Polynemus	92·60%	70·86	20·60	0·56	2·18	96·08	162·6	2·56	0·068

TABLE Ib

Analysis of the fresh prawns

Tendli	Metapeneus	100%	72·60	19·60	3·08	1·86	82·0	157·8	1·31	0·086
Sode I	Parapeneus	100%	73·89	21·41	2·68	1·26	92·0	176·0	2·30	0·060
Sode II	Parapeneus	100%	19·41	2·08	2·08	1·86	72·86	166·9	3·60	0·080
Golim	Acetes	100%	19·6	2·86	2·86	1·86	106·0	128·0	2·10	0·09

TABLE IIa

Biological value and digestibility coefficient of fresh fish

Name	Scientific Name	Level of Intake	Biological Value	Digestibility Coefficient
Surmai	Cybium	5%	75·56	84·96
		10%	67·97	81·18
		15%	59·37	76·14
Ghol	Sciœnea	5%	81·45	83·03
		10%	71·30	83·35
		15%	58·83	76·23
Mushi	Scoliodon	5%	72·88	82·18
		10%	62·14	84·19
		15%	53·26	70·75
Ravas	Polynemus	5%	79·5	85·87
		10%	67·96	85·16
		15%	52·20	67·52

TABLE IIb

Biological value and digestibility coefficient of fresh prawns

Name	Scientific Name	Level of Intake	Biological Value	Digestibility Coefficient
Tendli	Metapeneus	5%	71·80	86·39
		10%	65·67	85·81
		15%	59·62	73·19
Sode I	Parapeneus	5%	75·96	84·23
		10%	66·51	85·47
		15%	58·77	72·57
Sode II	Parapeneus	5%	78·19	85·72
		10%	74·85	87·09
		15%	60·84	73·22
Golim	Acetes	5%	75·64	83·66
		10%	60·74	86·03
		15%	54·46	71·87

The results show that both fish and the prawn muscle constitute cheap sources of animal proteins and essential minerals such as phosphorus, calcium and iron. Further, the

proteins are found to possess high biological value and digestibility coefficient.

T. C. APPANNA.
S. C. DEVADATTA.

Wilson College,
Bombay,
June 20, 1942.

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1 Mitchell, *J. Biol. Chem.*, 1924, **58**, 905.
2 Chick *et al.*, *Biochem. J.*, 1935, **29**, 1702, 1712.
3 Peters and Vanslyke, *Quantitative Clinical Chemistry*, 1932, **2**, 70.
4 Brigg, *J. Biol. Chem.*, 1922, **53**, 13.
5 McCrudden, *Ibid.*, 1909, **7**, 83 and 1911, **10**, 187.
6 Kennedy, *Ibid.*, 1927, **74**, 385.

THE EFFECT OF AN ILL-DRAINED SUBSOIL ON THE GROWTH OF COTTON AND GROUNDNUT

IN the cotton tract of the Central Provinces and Berar cotton is grown over nearly 3 million acres of land varying in the nature of soil and subsoil. One of the common types observed is that of soils apparently fertile having an ill-drained subsoil, locally known as *chopan*, at varying depths from 6 inches downwards. The physical and chemical nature of this subsoil has not been studied fully and the cause of its impermeability not yet ascertained. The mechanical analysis shows its clay content to be varying from 45 to 48 per cent. and in general its physical composition is very similar to the surface soil, locally known as *morand*. Some of the physical characteristics of these soils are given below:

Soils	Apparent specific gravity	Capillary rise of water in inches				Percolation of water in inches		
		1 hour	1 day	1 wk	2 wks.	5 min.	10 min.	15 min.
Morand	1·14	[illegible]·0	·7	15·0	20·0	2·0	5·0	6·0
Chopan	1·23	1·0	2·0	6·7	8·5	0·5	0·7	1·0

The *chopan* layer forms a sort of hard pan which is more or less impermeable to water and roots of plants. It causes water-logging and also affects the plant growth, yield and root development.

A pot culture experiment was arranged to study the effect of *chopan* subsoil at 6″, 9″ and 12″ depths on growth and yield of cotton and groundnut. Eight pots under each of the three treatments were filled with *morand* as surface soil and *chopan* as subsoil at depths of 6″, 9″ and 12″ respectively (referred to as treatments 1, 2 and 3 respectively). Eight pots were filled completely with *morand* to serve as control (treatment 4). One set of 32 pots filled in the above manner was sown early in July with Verum 434 cotton and another set with groundnut Ak 12·24 variety. The plants were watered every alternate day and mulching and weeding were done once a fortnight. Fortnightly observations were taken on general vigour and height. Finally plants in one pot of each treatment were washed with a fine jet of water to study the root development. The following observations are of interest:

(1) The vigour of plants was satisfactory and almost the same in all pots upto the end of August when some differences were noticed. The plants in control pots were green and healthy while those in pots having *chopan* at 6″, 9″ and 12″ depths showed slight yellowing.

(2) Even though the pots were irrigated on alternate days plants with treatments 1 and 2 showed early cessation of growth and tendency towards early maturity. The heights of the plants were in general less than plants under treatments 3 and 4 (control) and reached their maximum about 1 to 2 weeks earlier.

(3) The yield of cotton and groundnut ranged in the order of the depth at which the *chopan* subsoil was put in as shown in the following table. The yields in grams are the total of eight pots under each treatment.

The difference between any two treatments is significant and the controls have given the highest yield. This shows that the presence

Crop	Treatment I *Chopan* at 6"	II *Chopan* at 9"	III *Chopan* at 12"	IV All *morand*	Mean	S.E.
Cotton	47	52	79	81	64·8	0·96
Groundnut	474	511	561	685	557·8	3·12

of *chopan* layer nearer to the surface soil affects the yield adversely.

(4) The roots were found to grow easily up to the subsoil and then instead of penetrating the *chopan* layer curled upwards and formed a mesh (Figs. 1 and 2).

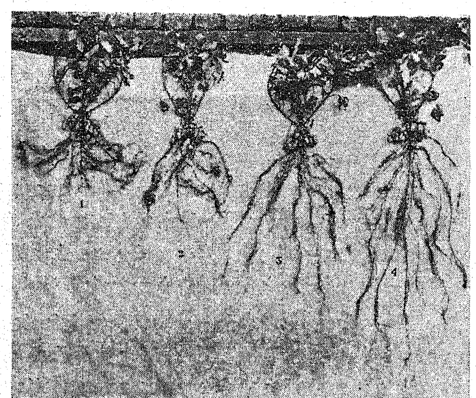

FIG. 1
Groundnut roots

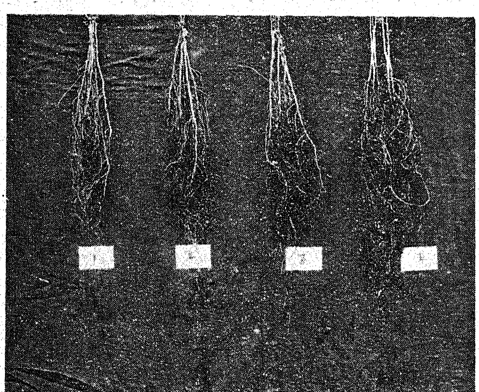

FIG. 2
Cotton roots

It is thus clear that the general performance of plants is dominated by the depth at which the *chopan* layer occurs. Further work on the problem is in progress.

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July 2, 1942.

MAGNESIA AS AN ADSORBENT FOR ASCORBIC ACID

AN adsorption technique has been developed for the preparation of ascorbic acid from plant extracts and successfully applied to the case of the Indian gooseberry, *Phyllanthus emblica*.

A survey of promising adsorbents including metallic oxides and hydroxides revealed that both fibrous alumina and light magnesia serve as good adsorbents, the latter being by far preferable. MgO has been reported to form a compound with ascorbic acid.[1]

Phyllanthus emblica, the Indian gooseberry, contains 2·0–2·5 per cent. ascorbic acid calculated on the basis of air-dried, seed-free material. The vitamin content decreases on storage. The alcoholic extract contains 3·8 per cent. total solids of which 7 per cent. is accounted for by ascorbic acid, the rest comprising mostly of tannins and resinous matter. Magnesia preferentially adsorbs tannins, and by passing the alcoholic extract through a column of magnesia, an extract free from tannins and rich in ascorbic acid is obtainable.

Owing to its basic character, magnesia oxidises ascorbic acid, partially and irreversibly. The maximum recovery of the acid in our preliminary experiments was as low as 57 per cent. This difficulty was overcome by (1) employing a low temperature (0° C.) for adsorption, and (2) using magnesia calcined at a high temperature. High temperature (1000° C.) calcination, not only suppresses the basic character of magnesia but also enhances its adsorption capacity. The relation between temperature of calcination and adsorption efficiency, awaits detailed investigation. Calcined magnesia is known to occlude oxygen and for the success-

ful application of this adsorbent, it is necessary to cool it out of contact with air, or preparing a paste of the material with alcohol before bringing it into contact with ascorbic acid and subjecting it to vacuum to remove oxygen. By taking these precautions, the loss of ascorbic acid during the process of adsorption can be reduced to about 5 per cent.

The ascorbic acid can be quantitatively eluted by bubbling either H_2S or CO_2 through the suspension of the adsorbate in water. The ratio of ascorbic acid to the impurities in the eluted extract is 1 : 2 and the concentration of the impurities can be considerably reduced by repeating the adsorption.

The adsorbent can be recovered and used repeatedly after calcination. The method is being employed for the preparation of ascorbic acid on a large scale.

B. N. SASTRI.
P. R. SIVARAMAKRISHNAN.
Indian Institute of Science,
Bangalore,
August 19, 1942.

[1] Yamato and Takeshi Hara, *Bull. Agr. Chem. Soc. Japan*, 1940, **16**, 1038.

DISTRIBUTION AND FEEDING OF THE POST-LARVAL FISHES OF THE TRIVANDRUM COAST

FROM November to middle of March, post-larval stages of various species varying in length from 5 to 35 mm., appear along with larval stages of other species, while towards the end of March, the latter gradually vanish from the catches until in April post-larval fish alone are caught. The maximum abundance of these, however, is recorded in February-March. Russell[1] carrying out similar investigations in the Plymouth area observed that the maximum abundance of post-larvæ occurred during the period between the second fortnight in April and the first fortnight in June.

Post-larvæ of *Cybium commersonii, Engraulis commersonianus, E. tri, Equula blochii, Lactarius delicatulus, Pristipoma stridens, Scomber microlepidotus, Sillago sihama, Sciœna albida* (?), *Sphyrœna jello* and *Therapon jarbua*[2] are usually caught along this coast. *Clupeatricauda, Stromateus niger, S. sinensis, Polynemus hepatadactylus* and *Upeneoides vittatus* are comparatively rare. However, each month has its own predominant species as may be seen from the following table:—

January—*Engraulis commersonianus.*
February—*Equula blochii.*
March—*Cybium commersonii* and *Scomber microlepidotus.*
April—*Sillago sihama.*
May—*Sphyrœna jello.*

On the other hand, *Lactarious delicatulus* is uniformly found during November to May.

Analyses of the stomach contents of post-larval fishes mainly reveal two facts: (1) The feeding habits of the post-larvæ more or less foreshadow the feeding habits of the adults of the same species. (2) The young fish exhibit selective feeding to a remarkable degree. The plankton of this coast during November to March consist mostly of crustacean larvæ, copepods, Leucifers, Mysids, medusoids, lemellibranch larvæ and Pteropods. From March onwards there is a gradual increase in the diatoms.[4] Copepods, Mysids and Leucifers form the main items in the food of the post-larvæ of *Scomber microlepidotus* and *Engraulis spp.* Similarly in predacious forms like *Cybium commersonii* and *Sphyrœna jello*, fish larvæ constitute the bulk of the stomach contents, even though small-sized crustaceans and other organisms abound in the plankton.

Adult specimens of *Lactarius* are known to be carnivorous, living on zoo-plankton organisms. Stomach contents of their post-larvæ (up to 15 mm.) commonly reveal a greenish mass, probably digested diatoms and occasionally complete specimens of *Coscinodiscus* and *Thalassiothrix*. Here we have a probable instance of alternative feeding. Such differences have been observed with European Herring.[3]

The presence of larval stages in October and the continued appearance of these up to March indicate that the spawning season of most of the marine fishes commences from September and extends to February or even March. *Equula blochii is probably* an early spawner and *Sphyrœna jello* seems to be a late spawner.

Lactarius delicatulus seems to spawn intermittently for, larvæ and post-larvæ of this, greatly varying in length, are simultaneously met with all through the season.

Thanks are due to Dr. C. C. John, Professor of Marine Biology and Fisheries for his general guidance and helpful suggestions.

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University of Travancore,
Trivandrum,
July 7, 1942.

[1] Russell, F. S., *Journ. Mar. Biol. Assoc.*, N. S., 1935, **20**, 150.

[2] Day's nomenclature is followed.

[3] Hardy, A. C., *Min. Agri. Fish. Fish. Invest.*, Ser. II, 1924, **7**, 3, 1–53; Lebour, M. V., *Journ. Mar. Biol. Assoc.*, N. S., 1924, **13**, 330 and Ogilvie, H. S., *Fisheries Scotland Sci. Invest.*, 1927, **1**, 1–10.

[4] Data kindly supplied by Mr. M. A. S. Menon of this Laboratory to whom I am greatly indebted.

REVERSE MUTATION IN *OPUNTIA DECUMANA*

THE prickly peer to which species of *Opuntia* belong has one species free from spine, called the spineless cactus. In this species when the joints (phylloclades) are young, tender fleshy spines are present, but these soon drop off, as the joint enlarges to form a spineless surface. The exact origin of the spineless cactus is obscure. Luther Burbank supposes that during the phylogeny of the cactus the original spineless type has acquired the spine in order to protect itself from becoming extinct during ages past. This hypothesis is purely conjectural. The large number of cactus species of the present day are all of the spiny type and the spineless species described are very few. For want of authentic records, it is, therefore, difficult to state whether spineless cactus arose as a mutation from the spiny type or *vice versa.*

"Reversion," "throw back" or "atavism" of characters is a phenomenon which is accepted by geneticists to indicate a reversion to the old or ancestral form. This phenomena affords a clue to the history of a character. In the light of this the reverse mutation which forms the subject of this note shows that the spiny character in cactus is primitive or ancestral compared to the spineless character.

The species to which the spineless cactus, grown in the Economic Botanist's Area in Poona (which has thrown off two spiny mutants), belongs is described by Burns (1940) as *Opuntia decumana* while Mehta (1923) includes it in *Opuntia ficus-indica.* The spineless plants have been under the constant observation of the writer for the past ten years, and until two years back no spiny type was seen to arise from the spineless type. Two years

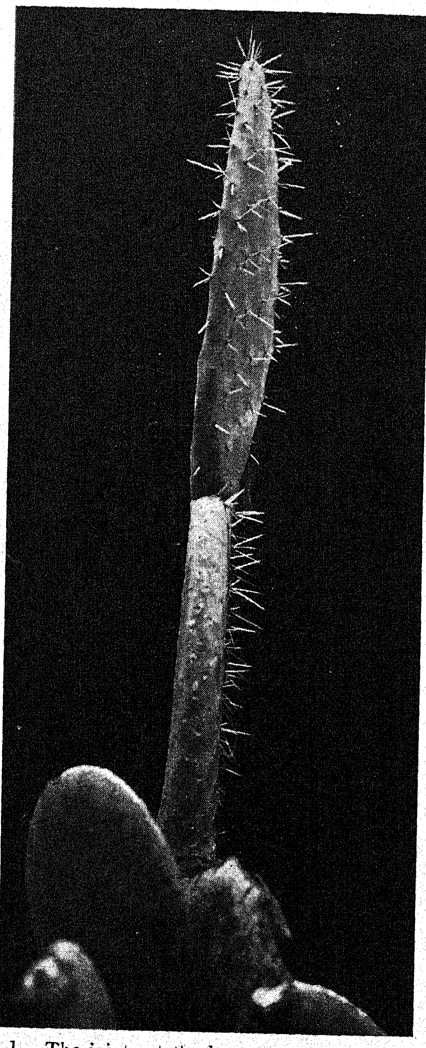

FIG. 1.—The joints at the bottom are spineless. The middle joint on edge view has spines on the surface to the right while the surface to the left is spineless.

back, however, in a trial undertaken to compare the effectiveness of spineless cactus as a live-hedge, one set or joint out of several hundreds of the spineless type that were planted gave rise to spiny and spineless joints subsequently. The photographs illustrate the type of somatic mutation which gave rise to the joints bearing spines.

A single spineless joint (phylloclade) was planted with one-third of its portion buried underground. From this several subsidiary spineless joints were produced and from one such arose a joint which had spines on one of its flat surface while the opposite surface was spineless (Fig. 1). This is evidently a case of sectorial chimera which has arisen due to somatic mutation. Later, from this joint showing spine on one side and none on the other arose another joint which likewise repeated the characteristics. In the second joint, however, some spines are to be seen along the margin of the spineless surface.

The other instance (Fig. 2) arose independent of the above in a plot where joints of spineless cactus were planted for multiplication. From this arose joints without spine and one having spines. The spiny type subsequently gave rise to joints bearing spines.

In the second example it is noticed that the few segments which bore spines profusely are giving rise to subsequent joints with fewer and fewer spines. This is an interesting example of successive reversions taking place in the course of two years.

The above two instances very clearly illustrate the sudden origin of a spiny cactus from the spineless type by somatic mutation of a bud from which the joints arose. On the hypothesis of reversion to ancestral or primitive character, it would appear that the cactus types having spines have had an earlier origin. If this is considered with Willis's age and area hypothesis, the extensive areas over which the cactus (spiny) has spread in its own home in South America and the greater number of species as represented by it would definitely indicate that the spineless cactus is of more recent origin.

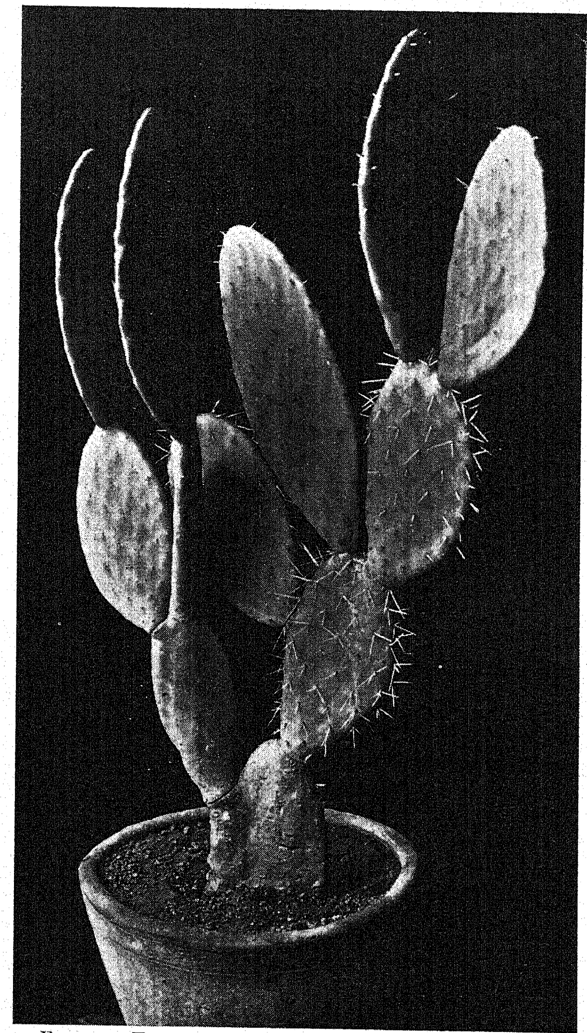

FIG. 2.—From a spineless joint, spiny joints have arisen to the right and spineless to the left. Of the spiny joints on the right, those below are completely covered with spines, while those towards the top show decrease in the number of spines.

L. S. S. KUMAR.

College of Agriculture,
Poona,

July 6, 1942.

[1] Burns, W., *Indian Farming*, 1940, **1**, No. 4, 160.
[2] Burbank, Luther, *A Partner of Nature*, Appleton Century Inc., 1939.
[3] Mehta, H. G., *The Agri. Jour. of India*, 1923, **18**.
[4] Willis, J. C., *Age and Area*, Cambridge Uuiversity Press, 1922.

REVIEWS

Radiology Physics. By John Kellock Robertson. (Chapman and Hall, Ltd., London), 1941. Pp. 270. Price 18*s.* net.

The ever-increasing applications of physics in medicine make it imperative that the medical student should have a working knowledge of certain branches of physics. This knowledge would be particularly useful if he later specialises in radiology. The book under review, by Professor Robertson who is well known for his *Introduction to Physical Optics*, provides a suitable medium for the acquisition of such knowledge in branches of physics useful to the radiologist.

The first three chapters deal with an elementary treatment of alternating current theory and the production, control and measurement of high voltages. All that the radiologist need know about cathode rays, positive rays and X-rays find a place in the next five chapters. Chapter IX is devoted to an elementary treatment of diffraction of light, spectra, infrared and ultraviolet radiations and their uses in medicine. Chapter X is about measurement of X-ray wavelengths and the simple theory of the origin of characteristic X-rays. Chapters XI and XII deal with X-ray absorption, production of secondary radiation, the principle of the Potter Bucky diaphragm and measurement of X-ray dosage while Chapter XIII is devoted to redioactivity. The next two chapters are of special interest as they are devoted to recent developments on the production and use of high speed particles. Brief and readable descriptions of the cascade generator, the million volt X-ray tube, the Van de Graaf electrostatic generator and the cyclotron form the subject-matter of Chapter XIV. This is followed up, in the next chapter, on artificial radioactivity, by a brief resume of the applications of nuclear physics to medical and biological problems. Most of the work done on these lines is of recent origin and this makes the book under review all the more valuable. The final chapter of the book is devoted to the production and use of high frequency-currents. The book may be recommended for the use of pre-medical students and radiologists. It is also suitable for general study by physics students of B.Sc. (pass) classes.

S. R. S.

Annual Review of Biochemistry, Vol. X. By J. M. Luck and J. H. C. Smith. (Annual Reviews, Inc., Stanford University P.O., California), 1941. Pp. xi + 692. Price $5.00.

The present review has been published in the second year of war which has extended to yet another European nation. The progress of scientific research, particularly its fundamental aspects, has received a regrettable but inevitable setback in most of the countries affected by the scourge of war. But a preliminary survey of the contents of the volume do not reveal any perceptible slacking of scientific effort during the year. It will, however, be noticed that of the twenty-four subjects discussed in the volume, no less than twenty-three have emanated from the various laboratories in America. This circumstance will not take away from the volume the international character which has constituted a special feature of these Annual Reviews.

The generous extension of American hospitality to European scholars who felt compelled to quit their fatherland, has, by introducing the international element, enriched American science; this is already reflected in the present volume under review.

In reviewing, in the field of Biological Oxidations and Reductions E. S. Guzman Barron refers to electromotively active systems—metalloporphyrins, flavoproteins and the more recently studied echinochromes. Valuable data regarding the oxidation-reduction potentials has been given and their significance in relation to cell respiration discussed. Reference has been made to activating proteins, whose isolation, purification and characterisation are proceeding slowly but steadily. Metalloprotein enzyme systems which include the various oxidases, catalase and carbonic anhydrase are referred.

The remarkable discovery of diphosphothiamin as the coenzyme of carboxylase has stimulated a considerable amount of work on the mechanism of the physiological role played by thiamin. The suggestion that diphosphothiamin might catalyse all the reactions where carbon dioxide acts as the

oxidising agent, opens up one of the most fruitful and spectacular fields of research.

Proteolytic enzymes are discussed by Bergman and his associate, while the non-proteolytic enzymes is reviewed by Tauber. Valuable reviews on the metabolism of carbohydrates, fats and proteins and amino acids appear in the present volume. Special attention should be invited to the reviews on Detoxication mechanisms and Harmones. Dieticians and pediatricians will find the review on Nutrition, illuminating and instructive. Reviews on soil deficiencies and animal nutrition and spectrometric studies in relation to biology, appear for the first time in this series. The latter review is presented in a form so as to be useful to those who wish to interpret spectroscopic data.

Barker's review on the chemistry and metabolism of bacteria discusses the nutrient and vitaminic requirements of micro-organisms and gives a survey of the work subsequently stimulated by the remarkable discovery of Wood and Workman regarding the utilisation of carbon dioxide. Other reviews relate to nitrogen fixation, protein monolayers, mineral nutrition of plants, plant-growth substances, bioluminiscence, water- and fat-soluble vitamins, biochemistry of nucleic acids, purines, pyrimidines, creatine and creatinine, sulphur compounds and carbohydrates and glycosides. The usual high standard has been maintained and the principal object of these reviews, a critical appraisement of the year's work, and a speculative but promising forecast of the future, has been more than amply fulfilled. We fervently wish that the present conflict will not in any manner affect the publication of this Annual which has come to be regarded as a landmark in the progress of Biochemistry.

Mechanism and Chemical Kinetics of Organic Reactions in Liquid Systems. A general discussion arranged by the Faraday Society. (Messrs. Gurney & Jackson, Ltd., London), 1941. Pp. 601 to 806. Price 15*sh.* 6*d.*

The book is a collection of papers contributed to a discussion in September last. Soon after the *Transactions of the Society* for December containing these papers was received in this country, a brief critical review was published in *Current Science* (Vol. 11, p. 202).

In 1937, the Faraday Society held a discussion on Reaction Kinetics in general and the present publication is a logical sequel. The earlier work dealt largely with the theoretical treatment of activation energy and reaction velocity, while the present one is naturally concerned with the application of these ideas. The fourteen papers that have been presented clearly indicate a unity of purpose, an application of exact technique together with physical understanding. The series of papers also draws attention to the necessity of a theory that envisages both the collision and the transition state methods of interpreting chemical reactions.

The publication is an illuminating work suggestive of further work in a rich field and should find a place in the library of every chemist.

Carnegie Institution of Washington: Year-Book No. 40, 1940-41. (Carnegie Institution of Washington, Washington, D.C.), 1941. Pp. xxxii + 346. Price $1.00 paper cover, $1.50 cloth binding.

The Carnegie Institution of Washington, which "occupies a unique and important place in the scientific affairs" of the United States of America, is dedicated to "the extension of man's fundamental knowledge of his environment". The report of the President which prefaces the Year-Book, outlines the way in which the scientific activities of the Institution have been oriented to meet the situation imposed on the Nation by war. "Events of the past two years have profoundly altered the plans and outlook of every scientific institution in the world, and of the great majority of individual scientists." Many of the long-range programmes of research in the field of pure science have now been changed or held in abeyance.

In discussing the function of scientific institutions in relation to the programme of defence the President writes: "There is not complete unanimity in this country as to how, or when, or to what extent the power of the nation should be exerted to defend our way of life. There is substantial unanimity, however, on the thesis that the power of the nation should be increased as rapidly as possible and to the maximum possible extent. Here the Institution has a very

definite duty. Military strength has been definitely demonstrated to depend, in no inconsiderable degree, upon the intelligent application of science to military devices and operations. As a great and unique scientific organisation of national extent, with its central offices close to the seat of Government, the Institution has a duty far beyond that of responding passively to the calls of Government for the loan of the services of members of its staff. It is called upon to participate actively, in co-operation with other scientific groups, in bringing to the aid of Government the co-ordinated intense effort of the scientists of this country, supplementing the activities of the armed services, in order that the weapons placed in the hands of the youth of the land may be fully adequate. The scientists of the Institution are discharging this duty to the full extent of their ability and opportunity."

The Carnegie Corporation of New York, through whose munificence the scientific activities of the Institution are kept alive, has recognized that the continued maintenance of the prominence of an Institution, involves the intensification of efforts in new directions and new approaches to old problems by the adoption of new methods offered by modern instrumentation. In pursuance of this progressive and enlightened policy, the Institution has installed a large cyclotron to attack the many borderland problems between physics and biology. A study has also been undertaken toward a new approach to human genetics.

While a substantial portion of the resources of the Institution are now harnessed for prosecuting the defence programmes, the administration has not overlooked the importance of keeping the fountain of fundamental research flowing. The President remarks: "Fundamental scientific research is almost completely stopped all over the world, except in this hemisphere. The inspiration passed from master to disciple, and the subtle evolution of great ideas when powerful minds collaborate, or compete, are part and parcel of the rapid progress of modern science. This implies continuity of effort. If the thread is broken it may be long before it can be mended. With science and scientists in other lands completely distracted by immediate requirements, an organization such as ours has a responsibility for preserving some of the more important threads in tact. This duty has not been forgotten, although its fulfilment becomes increasingly difficult." M. S.

CENTENARIES

Wright, Benjamin (1770–1842)

BENJAMIN WRIGHT, known as the father of American Engineering, was born in Wethersfield, Connecticut, October 10, 1770. Having a talent for mathematics, he studied surveying and he persuaded his father who was a petty farmer to move into the new settlements of New York and carried out land surveys of over 500,000 acres between 1792 and 1796.

As the area developed Wright interested himself in improving its transport facilities by constructing canals. The experience which he thus built up got for him a prominent place in the construction of the Erie Canal in 1817 which he completed in 1825. In executing the work, he gathered around him a remarkable group of young men all of whom afterwards developed into engineers of first quality and thus earned for Wright the familiar appellation 'Father of American Engineering'.

Wright died in New York City, August 24, 1842.

Reynolds, Osborne (1842–1912)

OSBORNE REYNOLDS, a British physicist, was born at Belfast, August 23, 1842. His father who was fourth wrangler and a school master, paid personal attention to his son's education and had admitted him into the workshop of a mechanical engineer before he entered the Queen's College, Cambridge. He graduated in 1867 as the seventh wrangler and became the first professor of engineering in the Owen's College, Manchester. This post he held till his retirement in 1905.

During his long tenure of professorship Reynolds made many investigations most of which sought to find mechanical explanations of physical phenomena like lubrication, flow of water in pipes and the concept of critical velocity, dilatancy of granular media, and group velocity of waves. The most extensive piece of experimental work he carried out was the determination of the mechanical equivalent of heat by the direct measurement of the amount of heat required to raise a pound of water from the freezing point to the boiling point.

Reynolds became a fellow of the Royal Society in 1877 and got its gold medal in 1888. His *Papers on mechanical and physical subjects* were published in three volumes in 1900–03.

Reynolds died in Somerset, February 21, 1912.

S. R. RANGANATHAN.
University Library,
Madras.

SCIENCE NOTES AND NEWS

Vegetable Insecticides in India.—The discovery of several useful vegetable insecticides and the possibilities of their cultivation in India are announced by the Forest Research Institute, Dehra Dun.

For controlling agricultural as well as household pests vegetable insecticides are preferred to others, such as, lead and copper salts, arsenic and nicotine, because they are non-poisonous to man and animals.

The growing demand for vegetable insecticides was hitherto met mainly by a plant called "derris" from Malaya, Dutch East Indies and Philippines. Investigations conducted by the Forest Research Institute have now shown that other plants bearing the same toxic content as "derris" are available in this country; and the existing material is rich enough for the preparation of effective insecticidal emulsions and powders. Their toxic content is capable of still further improvement by proper cultivation and treatment.

Certain parts of India, it has been found, possess suitable climatic and soil conditions for the introduction and cultivation of richer varieties of Malayan "derris". Experiments in this direction have already proved successful in Mysore, Cochin and Assam.

Alcoholism and Thiamin.—Heavy drinkers of whisky and other alcoholic beverages probably do not require extra amounts of vitamin B_1 to protect their nerves and keep them healthy. Experiments casting "considerable doubt" on the current theory that alcohol increases the body's need for this vitamin were reported by Dr. J. V. Lowry, Dr. W. G. Sebrell, Dr. F. S. Daft and Dr. L. L. Ashburn, of the U.S. National Institute of Health. In these experiments rats kept on the water wagon without exception developed the severe nervous disorder believed due to B_1 deficiency in alcoholism before their litter mates that were getting alcohol or whisky. The nervous disorder could be prevented and cured by the vitamin, regardless of whether the rats drank alcohol, water or whisky. These experiments give the first indication that alcohol does not require vitamin B_1 to help burn it in the body. They suggest that a person who sticks to a good diet could probably drink a quart of whisky daily without needing extra vitamin B_1 to burn the alcohol. If, however, he neglects his diet, as alcoholics probably do, and fails to eat enough food containing vitamin B_1, he would develop the nervous disorder. The whisky or alcohol could be blamed for causing the sickness by depleting the body of the vitamin.

Science, 95, 2467, p. 8 (Supp.)

The Indian Jute Industry and the American Bagging Problem.—According to the July issue of the Indian Central Jute Committee *Bulletin*, exports of raw jute from India during the eight months from July 1941 to February 1942 were 205,000 tons as against 142,700 tons and 387,500 tons during the corresponding periods of the 1940-41 and 1939-40 seasons respectively. The total volume of raw jute exports during the first three months of the Pacific War was reduced by more than one-fifth of the volume in the same period of the previous year. Exports of jute manufactures during the first eight months of the jute-year 1941-42 were 636,500 tons as compared with 581,400 tons and 762,700 tons in 1940-41 and 1939-40 respectively. The total jute trade during the period declined but not to the same extent as in the previous year.

The American Republics need bags in connection with a large percentage of their Agricultural Crops. Some idea of the importance of Indian jute to these countries may be gathered from the available import and consumption statistics. In 1940, Chile imported 6,000,000 jute sacks and produced an additional 3,000,000 from imported jute fibre. Argentine uses about 378,000,000 sacks a year. Brazil purchased about 48,000,000 lbs. of jute in 1940 and Peru about 25,000,000 lbs. Chile will require 24,000,000 sacks during 1942.

With the growing difficulties in the jute shipments and the dependence of America on jute bagging, there has been, of late, considerable experimentations for substitutes. Cotton bags and multi-wall paper bags are rapidly gaining the position lost by jute.

A synthetic jute factory is being established at Foxton, near Wellington, New Zealand, to manufacture synthetic jute for felt production, utilising wool-pack waste together with odd ends and pieces of cloth. In this connection it is gratifying to note that the Indian Central Jute Committee at its meeting held on July 25, 1942, approved of the extension of the programme of work of the Technological Research Laboratories of the Committee, Mr. P. M. Kharegat, C.I.E., I.C.S., presiding.

Although the Laboratories at present do not possess the necessary equipment for a full-scale work of this nature, the Committee decided to make an immediate start with the existing facilities, and to recommend to the Central Government for early sanction of necessary finance for some additional facilities.

The general nature of work proposed to be done in this connection will be, first to see to what extent jute can be used to replace fibres, such as flax and Italian hemp, which are now more or less unavailable in India; and, secondly, the production of ply threads of the greatest possible strength, regularity and durability.

Such work is also likely at the same time to be of value in connection with discovery of new or extended uses of jute.

A New Blackout Bulb.—A blackout bulb, writes Edwin Neff, in *Science*, 95, 2466, which eliminates need for special drapes and shades, gives ample light to avoid stumbling over

furniture, yet cannot be seen from the air has been successfully developed and tested by Army engineers at Fort Belvoir, Va., and will probably soon be on the market. The new bulb is heavily coated with black except for an orange button about the size of a nickle on the bottom. It burns on average house current and will sell for about 25 cents. One bulb per room will provide enough light to permit occupants to see each other plainly, as well as furniture, doors and windows. Only the usual household curtains, drapes or shades are needed when this bulb is the sole source of light. Army pilots and engineers tested the bulb recently in a tiny town in New Jersey (only forty houses). Each home was equipped with the blackout bulbs and shades and curtains left up. When pilots flew over they were unable to see a single ray of light. The bulbs were developed with the co-operation of the Nela Park Engineering Department of the General Electric Company at Cleveland, Ohio. Army engineers explained that orange was selected as the colour for light-emitting button, since it is near the red end of the spectrum, yet unlike red is not confused with exit lights. Red has been found to be the light least visible from the air.

While the blackout bulb will not permit reading or playing at cards, it is safer and more convenient than no light at all. It can be used to light sections of the house where there are too many doors or windows for the practical use of blackout drapes. One room of the house can be blacked out completely to permit reading with ordinary light, while the rest of the house can be lighted with the special bulbs.

Reclamation of Agar.—Hilda G. Macmorine describes a method (*Can. Public Health J.*, 1942, 23, 39) for reclamation of agar from used culture media. The agar is melted by autoclaving and poured into cylinders. Media in petri-dishes heavily infected or containing blood or serum are placed into boiling water. The melted agar filtered through cheese cloth to remove the coagulated blood and serum and the bulk agar put into cylinders as before.

After the agar sets, it is removed, cut into thin slices and washed well with cold water free from broth. The washed agar is remelted, decolourised with carbon black and filtered through the Buchner funnel lined with filter-paper and paper pulp.

The resulting clear agar solution is autoclaved for 1½ hours at 250° F., with potassium oxalate and potassium carbonate. The hot agar is then filtered and poured into two volumes of cold acetone with vigorous stirring. The agar comes down in fairly granular form, which is filtered in a Buchner funnel, washed with acetone and dried. Ethyl alcohol may be used for precipitating the agar, but the precipitate is rather colloidal and difficult to separate by filtration.

This modified agar gives a hardness, only slightly inferior and is in no way bactericidal.

V. S. G.

Ergot Cultivation.—The ergot fungus (*Claviceps purpurea*) is parasitic on various grasses particularly rye grains transforming them to hard sclerotia. Infection takes place at the flowering period. The sclerotium is rich in ergotoxine which is highly valued in medicine. The conidial or *sphacelia* can be cultured on synthetic media and stored at low temperatures (Melville, R., in *Pharm. J.*, 1941, p. 178) when the glumes of rye flowers open and the anthers are exserted out, they can be infected with the conidiospores. By following this method, ergot has been cultivated on a large scale in Europe.

In India *Sphacelia sorghi* has been known to occur on *Sorghum vulgare*, *Andropogan caricorus*, *Ischœmum*, *Brachypodium* and other grasses (*Cur. Sci.*, Nov. 1941). Formation of sclerotia takes place, but the perfect stage has not been observed. If culturing of *Sphacelia* occurring in India be started, ergot cultivation can be attempted on a large scale. M. J. T.

Erosion in Cultivated Uplands.—The Punjab has led other provinces in India in pioneering anti-erosion measures on a large scale; indeed, this has developed into one of the main activities of the Punjab Forest Department which in collaboration with the Revenue, Agricultural and Co-operative Departments, have done much to arouse and educate the public into these problems. In a Bulletin entitled "Erosion in the Cultivated Uplands of the North Punjab and Its Cure" (Government Press, Lahore, 1941), Mr. H. M. Glover, I.F.S., records the success of the Co-operative Land Reclamation Societies in carrying out anti-erosion measures. No details are given but the Bulletin includes very telling photographs, some of these taken from air. In a Foreword, Mr. F. L. Brayne makes the point that in the North Punjab, "the land aches for labour" and that if tangible results are to be obtained "every one shall work together" and that the best results are obtained when such co-operative endeavour is "scientific". Mr. Glover's Bulletin tells in simple language how the Forest Department is ready and eager to assist with such scientific advice any one who cares to apply.

Wood preservation is a highly technical job and the average layman is not well placed in choosing a process which is efficient for his particular needs; he is apt to overlook the fact that the ideal wood preservative is yet to be discovered; that each process has its own merits and limitations. And the high sounding, contradictory and sometimes extravagant claims made for the proprietary preservatives tend to confuse him still further. It is to educate such prospective users that "A Short Note on Wood Preservation for Users in India" by Dr. D. Narayanamurthy has been published as *Indian Forest Bulletin* No. 110 (Manager of Publications, Delhi, 1942. Price As. 12 or 1*sh*.). A broad outline is given, in non-technical language, of wood preservatives, the processes of treatment, costs and the handling of timber subsequent to treatment. The text is illustrated with four good photographs and a figure with lettering none too easy to decipher.

Under "Other Treating Processes", "Powellsing" (which makes use of molasses as the preservative base) is a notable omission. It would have considerably added to the value of the publication to the layman if some authentic "service records" of treated timber (as for example those maintained and published by the American Wood Preservers' Association) had been included; such data although not always applicable to Indian conditions would still be indicative of the comparative "life" one could expect for timber treated with the different preservatives.

Indian Timber for Aircraft and Gliders.—With India undertaking aircraft and glider construction, interest in Indian woods likely to be of use for this type of work has been intensified.

The Forest Research Institute, Dehra Dun, which has investigated the subject and organised tests for compiling comparative information on the strengths of Indian woods, has just published a "Note on Indian Timbers for Aircraft and Gliders". According to this publication, Indian spruce of aircraft standard is obtainable in lengths up to possibly 10 or 12 feet, but the larger lengths of clear timber are not likely to be available. Small quantities of Indian aircraft spruce have already been extracted and put into use. Arrangements are now in train to organise the supply of larger quantities, and a forest officer has been placed on special duty to organise continued supplies of specially selected spruce and fir for aircraft work in India.

The wood mainly used for aircraft work in other countries is Sitka spruce, a tree of the western Canadian and American forests, which is not indigenous in India. But India also has a spruce species, and if properly selected wood is used, it compares favourably in strength with Sitka spruce. The Indian species is, however, a very knotty wood, and it is difficult to obtain clear aircraft material in long lengths to meet all the requirements. Even with Sitka spruce only 5 to 10 per cent. of the timber cut is suitable for aircraft work, but good lengths of clear timber free of knots can be obtained with that species.

The note emphasises the need for proper selection and gives specifications for the selection of Indian spruce for aircraft work. It also suggests that one or two of the lighter Indian hardwoods, such as *champ* or *bonsum*, may possibly fill the deficiency where longer lengths of aircraft timber are required.

Brief descriptions of several Indian species considered suitable for making aircraft plywood and propellers are also given.

The Occurrence of the Nematode Genus *Oswaldocruzia* in India.—The genus *Oswaldocruzia* (Family Trichostrongylidæ) was erected by Travassos in 1917. Quite a large number of species of this Genus have subsequently been described from Amphibian hosts in various countries; but so far as I am aware this genus has not hitherto been reported from India. Baylis and Daubney described one species from Nicobar Islands in 1923. While collecting Nematodes from various Amphibian hosts, I obtained a few specimens of *Oswaldocruzia* from the intestine of the common toad *Bufo melanostictus* at Lucknow. This would thus be the first record of the Genus in India. The present form affords interesting material for study and appears to be new to science. A detailed account of its morphology and toxonomy will shortly be published. M. B. LAL.

Working of the War Resources Committee.—In a communique the Government of India announce:—The President of the War Resources Committee is His Excellency the Viceroy and his Deputy is the Honourable Sir Homi Modi, Supply Member, by whom the chair is occupied in the ordinary course.

The Honourable Members for Commerce, Communications and Finance, form the body of the Committee and a representative of the Commander-in-Chief, who is constitutionally a Member of the Committee, also attends. It is not yet known whether the recent expansion of the Viceroy's Executive Council will result in any changes in the composition of the Committee.

The Committee deals with matters arising out of the Grady Report and those initiated by the various Departments or by the Chairman and Secretariat of the Committee. Where departments other than those already represented in the Committee are affected the Honourable Member concerned is invited to attend or send a representative.

Decisions of the Committee carry the full authority of the Executive Council and the departments concerned see to their execution. Progress Reports are usually asked for by the Committee in order that it may keep in touch with developments.

The Secretary of the Committee is Lt.-General T. J. Hutton, till recently G.O.C. in Burma and formerly Chief of the General Staff, India, and it is understood that Mr. T. M. S. Mani, I.C.S., of the Communications Department, will shortly assume the appointment of Deputy Secretary.

University of Calcutta.—Mr. S. R. Palit, M.SC., of the Indian Lac Research Institute, Ranchi, has been admitted to the Degree of Doctor of Science of the University of Calcutta on a thesis entitled, "Fundamental Physicochemical Investigations of Solutions of Resins, Cellulose derivatives and Soaps".

SEISMOLOGICAL NOTES

During the month of July 1942 five moderate and three slight earthquake shocks were recorded by the Colaba seismographs as against seven slight ones recorded during the same month in 1941. Details for July 1942 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
		H.	M.	(Miles)			
3	Moderate	08	20	620	Near Lat. 25°N., Long. 65°E., in Baluchistan	..	Felt in Karachi. Karachi experienced two earthquake shocks of moderate intensity this morning at 8-30. It is reported that doors and windows rattled. No damage is, however, reported A.P.
4	Slight	14	17	630	..	..	Probably an aftershock of the previous one.
8	Moderate	12	26	10110	..	..	
10	Slight	08	51	1570	..	..	
12	Moderate	10	35	10150	..	..	
24	Slight	10	30	2350	..	..	
25	Moderate	11	53	3570	..	125 km. (Probable)	
30	Moderate	04	19	4030	Lat. 4°S., Long. 129° E., near the Island of Ceram in Banda Sea.	80 km.	

MAGNETIC NOTES

July 1942 was more disturbed than the preceding month. There were 14 *quiet* days, 16 days of *slight* disturbance and one of moderate disturbance as against 3 quiet days, 18 days of slight disturbance, 7 of moderate disturbance, 2 of great disturbance and one of very great disturbance during July of last year. The day of the largest disturbance during July 1942 was the 11th while the quietest day was the 4th. Characters for individual days were as follows:—

Quiet days	Disturbed days	
	Slight	Moderate
2–5, 9, 14, 18–19, 21, 22, 24, 29–31.	1, 6–8 10, 12–13, 15–17, 20, 23, 25–28.	11.

No magnetic storm was recorded during July 1942 while two storms (one moderate and one very great) were recorded during July of last year. The mean character figure for July 1942 is 0·58 as against 1·23 for July 1941.

M. R. RANGASWAMI.

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 90, No. 4611.

"Journal of Agricultural Research," Vol. 64, No. 7.

"Agricultural Gazette of New South Wales," Vol. 53, Nos. 5 and 6.

"Annals of Biochemistry and Experimental Medicine," Vol. 2, No. 2.

"The Journal of Chemical Physics," Vol. 10, No. 4.

"Journal of the Indian Chemical Society," Vol. 19, Nos. 4-6.

"Experiment Station Record," Vol. 86, No. 4.

"Indian Forester," Vol. 68, No. 8.

"Indian Forest Records," Vol. 5, No. 1.

"Indian Farming," Vol. 3, No. 7.

"Quarterly Journal of the Geological, Mining and Metallurgical Society of India," Vol. 14, No. 1.

"The Indian Central Jute Committee," Vol. 5, No. 4.

"The Bulletin of the American Meteorological Society," Vol. 23, No. 2.

"Journal of the Indian Mathematical Society," Vol. 6, No. 1.

"Journal of Nutrition," Vol. 23, No. 4.

"Nature," Vol. 149, No. 3787.

"American Museum of Natural History," Vol. 46, No. 3; Vol. 47, No. 1; and Vol. 49, No. 3.

BOOKS

"Mass Spectra and Isotopes," by F. W. Aston. (Edward Arnold & Co., London), 1942. Pp. xii + 276. Price 22*sh.* 6*d.*

"Plastics in Industry," by 'Plastes'. (Chapman & Hall, London), 1942. Pp. xiii + 248. Price 15*sh.*

"The Chemical Analysis of Ferrous Alloys and Foundry Materials, Modern Practice and Theory." (Chapman & Hall, London), 1942. Pp. xv + 362. Price 28*sh.*

"Mechanism and Chemical Kinetics of Organic Reactions in Liquid Systems," A General Discussion held by The Faraday Society. (Gurney & Jackson, London), 1941. Pp. 601 to 806. Price 15*sh.* net.

975-42—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science", Bangalore.

CURRENT SCIENCE

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MALARIA AND ANTIMALARIALS

AMONG the several diseases which afflict this country, malaria occupies the foremost place; it is the largest single disease endemic in India. Annually a third of the population of this sub-continent is said to suffer from malaria, and the percentage of deaths among them is appallingly high. Those who survive the attack suffer from its after-effects which often leave a permanent injury on the patient. The loss of economic man-power and human efficiency due to this disease in the British Empire has been estimated at 52 to 62 million pounds a year, more than half of which is shared by this country.

For decades this widespread disease has been allowed to go practically unchecked and no determined and sustained effort commensurate with the magnitude and seriousness of the problem, has been put forward. In this connection, special mention should be made of the Rockefeller Foundation for the valuable services rendered to the Provincial Governments in conducting malarial surveys in the several provinces, and for furnishing the necessary technical personnel.

Methods for combating this disease are well known and they have been widely and successfully adopted in other countries like Italy and Greece. They consist of the destruction of larvæ, the draining of swamps, mechanical protection against mosquitoes and prophylaxis by quinine or atebrin and plasmoquine. The problem in this country is complicated by the undernourished and poverty-stricken condition of its people. The *per capita* consumption of quinine in India as compared with other malaria-stricken countries is only three and a half grains

as against the 16 and 24 grains respectively in Italy and Greece. The question of malaria control is, therefore, closely connected firstly, with an adequate supply of prophylactic drugs at prices which the average Indian can afford to pay, secondly with the speed and efficiency with which the sources of vectors could be minimised if not abolished and thirdly, with the raising of the standard of nourishment among the masses.

Col. Chopra, in an admirable review of the position of quinine in this country, computes that the maximum potential demand for this drug is 1,500,000 lb. The Public Health Commissioner to the Government of India is of the opinion that "there is no question of the effective treatment of malaria in India until the consumption of quinine approximates to 500,000 lb." Sir Patrick Hehir has estimated that for India, 970,000 lb. of quinine would be the minimum necessary for a successful tackling of the problem of malaria. At the moment, India's annual production of quinine lies between 60 to 70 thousand pounds, which is supplemented by another 130,000 lb. of imported material. These figures reveal the utter helplessness of the situation and call for the most vigorous effort on the part of those interested in the control of this preventable disease.

The Royal Commission on Agriculture realised the acuteness of this problem and made far-reaching recommendations calculated to make India self-sufficient with regard to this drug. They have pleaded for a rapid expansion of the acreage under cinchona; the evidence presented before the Commission had revealed that for many years the progress of cinchona cultivation in the country, had remained practically stagnant, in spite of the circumstance that large tracts of territory authoritatively pronounced to be suitable for its propagation, were found to be available. In view of the imperative urgency and vital importance of this matter, the Royal Commission urged that the Central Government should take up the responsibility of producing and distributing this drug.

In 1923, a committee of representatives of the various Provincial Governments interested in the propagation of cinchona, was called with a view to elicit their advice regarding the extent and manner in which the recommendations of the Royal Commission could be given effect to. The Committee was immediately faced with the financial aspects of the problem and recommended a scheme through which all profit which might accrue would be shared equally by all the consumers. The Malaria Commission of the League of Nations emphasised the importance of quinine as the prophylactic *par excellence* in the remission of malaria. In spite of all this forceful expression of authoritative opinion and in the face of the brilliant examples of public health administration in other parts of the world, nothing substantial or effective has been achieved in controlling the disease in India. Considerations of philanthropy, humanity and charity and of public health obligatory on all Governments, have been overpowered by the modern "shopkeeper instinct". We must here refer to the unostentatious and silent part played by indigenous systems of medicine which have been bringing relief to the millions of the malaria-stricken in

rural districts. Captain G. Srinivasamurthy (formerly Principal of the School of Indian Medicine, Madras), who is one of the foremost exponents of Ayurveda, has revealed to us that during the days of the East India Company, a number of indigenous antimalarials were "authorised as official substitutes for cinchona and its alkaloids. They were also included in the pharmacopœia of India which was then in use as supplement to the British pharmacopœia". It is regrettable that these specifics have not continued to receive the official recognition with the rise of quinine as the official drug for malaria.

Cinchona was introduced in India and Java at about the same time; its propagation made considerable headway in this country and at one time it looked as though the country would not only satisfy its requirements but produce a surplus with which a prosperous but not a profiteering export trade could be built up. But Java which was backed up by intensive methods of scientific selection and propagation, evolved varieties which yielded richer percentages of the alkaloid. The Dutch are the foremost in the field of plant improvement and have successfully demonstrated their scientific talent and skill with regard to a number of other economic crops like the sugarcane and the tobacco. The valuable experience in these lines, was utilised for the improvement of cinchona which has been responsible for the supremacy of Java in the production of quinine. Overproduction of this drug threatened to reduce the prices to an uneconomic level but the "Kina Bureau", a powerful syndicate, stepped in to control the world price of quinine. Col. Chopra writes in this connection:

"The Kina Bureau has tried and has been successful in effecting regulated and gradual reduction of the cinchona areas to proportions fitted to what the world can afford to buy and not what it really needs. In this way the price has been maintained at a level that leaves a profit both for the plantations and the factories."

"It follows from all this that it would be absolutely futile to expect any large reduction in the price of quinine under the present conditions. So efficient is the control that even the great world-wide depression during recent years has not affected the price of quinine, which still remains at Rs. 18 per pound, which was the price fixed so long ago as 1926."

This monopoly has been challenged by Germany. As a part of their programme of colonial expansion, Germany was keenly interested in the synthesis of specifics for all the tropical diseases like sleeping sickness, yellow fever, malaria, etc. Intensive work on synthetic antimalarials was launched and in the year 1926, the Elberfeld Chemical Research Laboratory of the I.G. Farbenindustrie, announced the synthesis of plasmoquine. Four years later Atebrin was synthesised. These two synthetic drugs have now been in use in this country as antimalarial specifics. Medical opinion in India, while recognising the efficacy of the two drugs, is averse to their general adoption. These drugs have to be administered under careful medical supervision; otherwise they may prove highly toxic. So far as mass treatment of malaria is concerned, quinine still holds the field, since the drug can be safely administered and is even recommended for self-medication. But the price of quinine is too high. "We cannot get away from the fact that quinine is the rich man's remedy, while malaria is the poor man's heritage; but let medicine once admit and practise the

value of the other alkaloids and many Indian areas might then be turning out febrifuge at costs more suited to the poor. For, with a change of medical opinion and practice we could make use of kinds of cinchona that do not demand java soil and climatic conditions for their best development." This extremely helpful suggestion made by the Government Cinchona Department and Factory in Bengal, is supported by Col. Chopra who adds, "It is unfortunate for India that of all the alkaloids of cinchona bark, the merits of quinine alone should have been recognised by the medical profession, with the result that a monopoly has been created for the plantations and factories of Java. A reference to the history of the treatment of malaria in a recently published work by Lieut.-Col. R. Knowles and Senior-White, shows that this routine use of quinine sulphate is more or less an accident and that 'it is very far from certain that quinine is the best alkaloid of cinchona bark to use. Both quinidine and cinchonidine are more efficacious with regard to their anti-malarial power'. The important investigation carried out by Fletcher in Kuala Lampur in the Malay States and the experience at the Calcutta School of Tropical Medicine show that alkaloids of cinchona bark other than quinine are quite effective in the treatment of malaria if given in the usual doses in which quinine is given. The total alkaloids of the bark in the form of cinchona febrifuge have been used in the Carmichael Hospital for Tropical Diseases and at the out-patient department of the School for many years with very satisfactory results". In view of this clinical evidence, it is difficult to resist the demand for using the total alkaloids in place of quinine. This will cheapen the cost of production, facilitate the utilisation of the quinine-poor barks now considered uneconomical for the extraction of quinine and conserve the anti-malarial resources of the country.

The loss of Java has increased the acuteness of the problem a thousandfold. The price of quinine, which was fixed at Rs. 18 by the Kina Bureau has inflated to Rs. 130 per lb. The synthetic antimalarials have practically vanished from the Indian market. It is high time that the Government realises the importance of taking immediate steps to make the country self-sufficient with regard to this most important drug. In addition to this, it is necessary that the antimalarial specifics of established reputation in the indigenous systems of medicine, should be investigated with the co-operation of the Pandits and the Hakims. Investigations on the breeding of hardier and richer strains of cinchona should be undertaken and these researches may be appropriately financed by the Imperial Council of Agricultural Research, while researches on synthetic antimalarials are to a certain extent being financed already by the Board of Scientific and Industrial Research. A Central Advisory Board to co-ordinate and direct these activities should be constituted. This is a matter which demands the earnest attention of the Central Government.

THE SOURCES OF THE RIVERS INDUS, SUTLEJ, GANGES AND BRAHMAPUTRA

BY

D. N. WADIA

(*Mineralogist, Government of Ceylon, Colombo*)

SINCERE thanks and congratulations of all geographers and of Indian naturalists in particular are due to the Rev. Swami Pranavananda for publishing results of valuable explorations conducted by him during his four pilgrimages in the regions of Mt. Kailas and Manasarowar in Western Tibet. This trans-Himalayan district, lying just north of the Central axis of the Himalayas, held in great veneration by the people of India for 4,000 years, possesses the highest interest geographically, for it is the tract of mountains from which the four greatest rivers of India take their rise. This ground is sanctified by traditions going back to 2000 B.C., being mentioned with reverence in the Vedic hymns of the early Aryan settlers of India. There is reason to believe that this was the part of the Himalayas that the early Aryans were most acquainted with in the centuries following their migration to the plains of India. The beautiful, and in many cases highly expressive poetic names they have given to the peaks, passes, rivers and glaciers of this part of the Himalayas are reminders alike of the courage and enterprise of the Aryan pilgrims as of their love and admiration for the mountains and of their familiarity with them. Few other races of the world have at such early age in history adored mountains and snows, or enshrined them in poetry or mythology; for in most parts of the world mountains were regarded with horror and dread, to be shunned by all decent people for the ordinary pursuits of life.

Judging by the dimensions of the mountain-areas they drain, the four rivers, Indus, Sutlej, Karnali (the longest of the head-tributaries of the Ganges), and the Brahmaputra are the most important Himalayan rivers that drain the everlasting snows on the Indo-Tibetan water-shed and discharge their fertilising waters on the dry plains of India. The sources of these noble rivers, in the sense of modern geographical knowledge have, for over a century, been the subject of controversy among explorers, naturalists and the official surveyors of the Government of India. Although traditions and immemorial beliefs of the early Aryans, which must have had their origin in the explorations of the more intrepid mountaineers among the annual pilgrims, had already accumulated some remarkably accurate facts about the origins of these rivers, this knowledge was so enveloped in mythological and legendary fancies that for geographical purposes it was as good as a sealed book. In 1790 Major Rennell, the Surveyor-General of Bengal, published a map in which the 800-mile course of the Ganges above Hardwar was shown to pass through Kashmir and Ladakh! Since then a number of official surveyors as well as explorers, both of the Survey of India and of foreign countries,—Captains Raper, Webb and Herbert; the Chinese explorers Klaporth, Rhurs, and D'Anville; W. Lloyd and Alexander Gerrard, Henry Strachey, Sandberg, Pt. Nain Singh and Col. Ryder from India have each made contributions in discovering the heads of tributary-streams, springs or glaciers which may be claimed as the sources of these rivers. Sven Hedin, the reputed Swiss geographer, came late in a long line of distinguished Himalayan explorers and made extensive journeys in Tibet and Trans-Himalaya in 1907-10. Sven Hedin's great work, *Southern Tibet*, published in nine volumes in 1917 is, as mentioned by Burrard, a complete library of Tibetan geography and particularly of the region across the axis of the Kumaon-Nepal Himalaya, wherein he has unravelled a series of important facts of orography and hydrography. Among the many genuine discoveries revealing trend-lines of mountain systems and the inland drainage system of Tibet, Sven Hedin has also claimed to be the first to have found the sources of the Indus, Brahmaputra and Sutlej, for thus he speaks in one characteristic passage:

> "... I revelled in the consciousness that, except the Tibetans themselves, no other human beings but myself had penetrated to this spot. ... Providence had secured

for me the triumph of reaching the actual sources of the Brahmaputra and Indus, and ascertaining the origin of these two historical rivers. ... Not without pride but still with a feeling of humble thankfulness, I stood there, conscious that I was the first white man who had ever penetrated to the sources of the Indus and Brahmaputra. ... No white man had ever seen its source (*i.e.*, of the Sutlej) before now."

Later facts brought to light by Swami Pranavananda from his four long and arduous journeys during the years 1928-38 in the Manasarowar-Kailas region, involving a whole year's stay at one time in this inhospitable country, have raised some doubts regarding Sven Hedin's conclusions. Though not a professional geographer, the Swami has made a record of most interesting, accurate and painstaking observations of natural features and phenomena which provide valid data on the intricate question of fixing the sources of these rivers. The Swami's observations show some discrepancies and inconsistencies in Sven Hedin's discussion regarding the sources of the Indus and Brahmaputra. The sources of many great rivers are usually matters of dispute and long controversy, since the exact point of origin of what is to be regarded as the principal tributary may vary materially with the point of view adopted by the different observers, particularly if the river in question has, as is often the case, a multiple number of head-streams. Is it the head tributary with the largest volume of water, or is it the tributary with the greatest length of course from the water-shed, or the melting end of the glacier, that is to be regarded as the source-stream? Or is local tradition or immemorial belief of the people of the surrounding country to determine the source? It is only in rare cases that all the three factors combine to give the same result; usually it is one of the three that is of preponderating importance in deciding the issue. Sir Sidney Burrard, late Surveyor-General of India, has well cited an interesting example of this. "Some writers define the source of the river as the point of its course that is most remote from its mouth. Colonel George Strahan has shown that if this definition be applied to the Ganges, its source will not be Himalayan at all, but will be near Mhow in Central India at the head of the Chambal!" Local tradition has proved in several cases a correct guide in deciding such questions, especially in the case of river sources held in sanctity for millennia and visited annually by thousands of pilgrims, who in their peregrenations (*pradakshinas*) visit every ramification of the head-stream to the glacier-feeders.

Swami Pranavananda's book *Exploration in Tibet* (University of Calcutta, 1939), deals with the Kailas-Manasarowar part of Tibet, a region of sublime beauty and grandeur, encompassing some 3,500 sq. miles of country, a medley of high mountains above 20,000 ft., lakes and glaciers, which is the nourishing ground of the four greatest rivers of India. From his camping quarters in a monastery on the south shore of the twin-lakes Manasarowar and Rakas Tal, the Swami had unique opportunities of surveying the country around and investigating the merits of the various rival theories as to the sources of these four rivers, which all lie within a radius of 30-60 miles from his camp at the monastery of Thugulo. In his book Swami Pranavananda discusses all the relevant facts about the sources of the rivers Indus, Sutlej, Karnali and Brahmaputra as fixed by the previous observers and by Sven Hedin and presents a fair picture of the state of the controversy before he commenced his own investigation during his numerous *pradakshinas* round the foot of Mt. Kailas and the shores of the holy lakes. Although the last word cannot yet be pronounced on this subject without examining the bearings of the various physiographic factors involved and measurements of the various courses and the quantity of water carried by them, the conclusions to which the Swami has arrived are likely to meet with the approval of most geographers. After actual verification by personal observations of the actual sites he accepts the judgment of hoary tradition and sums up his conclusions as:

"..., the source of the Sutlej lies in the Kanglung glaciers, east of Manasarowar, 65 miles from Barkha.* The

* Barkha or Parkha is a post stage and official Tibetan transport agency station situated one mile north of the north end of Rakas Tal (*Rakshas Tal*).

source of the Indus is in the springs of Senge Khambab (half a mile north of Bokhar Chu), north of Kailas, 53 miles from Barkha. The source of the Brahmaputra is in the Chemayun-dung glaciers, two days' march east of the Kanglung glaciers or 92 miles from Barkha, and the source of the Karnali is at the Mapcha Chungo spring, about 23 miles northwest of Taklakot."

This conclusion will be generally acceptable to future investigators, for it leaves the question open for the adoption of other criteria for fixing river sources after the necessary exact and quantitative estimations have been carried out. Other glaciers, springs and divides may then be regarded as the sources of these rivers, though the change is not likely to be very material in two or three of these rivers. But even when this is done, the terrain in the immediate periphery of Kailas-Manasarowar will still remain the nidus, or cradle of four of India's largest rivers.

A paper containing the resume of Swami Pranavananda's observations was read at a meeting of the Royal Geographical Society, London, and although it aroused curiously little comment at the time, at this one of the world's most important centres of geographical enlightenment, it is apposite to conclude this note with the remarks made at this meeting by Dr. T. G. Longstaff, the celebrated Himalayan explorer and surveyor. While expressing himself in full agreement with Swami Pranavananda's acceptance of the traditional sources of the four rivers the veteran Dr. Longstaff said, "It savours of impertinence for Europeans to assert their views against the usage of other civilizations". And in this tribute by him to the Swami all acquainted with travel in the Himalayas will heartily concur:

> "Those who have travelled in Tibet must admire the character of the Swami, displayed by his omission of all reference to the hardships he must have suffered during his winter journeys in this inhospitable region."

BLOOD GROUPS OF THE BHILS OF GUJARAT

BY

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(Anthropology Laboratory, Lucknow University)

THE Bhils and the Chenchus have been found to be racially akin on the basis of the coefficients of racial likeness worked out from Dr. B. S. Guha's measurements.[1] Otherwise also, the Chenchus are popularly known as the closest relations of the Bhils, but they differ very much in their blood groups. Macfarlane tested 44 bloods from the Bhils of both sexes in the Kannad Taluk of the Aurangabad District in the extreme north-east. She found 31·8 p.c. O, 13·6 A, 52·3 B and 2·3 AB. This result if corroborated should be considered highly significant. "It may be", writes Macfarlane, "that in the Bhils we have one of the reservoirs of group B in India from which it has percolated to higher social castes, for the Bhils have an ancient tradition as soldiers and artisans".[2] In another paper on "Blood Groups in India"[3] Macfarlane has recorded the blood groups of 140 Bhils and she found 18·6 p.c. O, 23·6 p.c. A, 41·4 p.c. B and 16·4 p.c. AB. I do not know where this group was examined, as the reference given in the paper does not mention it. The large incidence of B, 52·3 p.c. in one case and 41·4 p.c. in another, could be explained if we took the Bhils as a highly heterogeneous group, for according to the data available the B percentage is found higher among mixed groups and may have something to do with hybridization.[4]

At the invitation of the Gujarat Research Society and in collaboration with Dr. G. M. Kurulkar, Professor of Anatomy, S. G. S. Medical College, Bombay,[5] I have recently done some anthropological investigations among the Bhils of Gujarat (Panchmahal District) and the bloods of 369 Bhils of both sexes were typed by me. The data from the Bhils give the following percentage distribution: 37 p.c. O, 27·5 p.c. A, 26·0 B and 9·0 AB. Macfarlane's estimate of B concentration could not be corroborated and we have therefore to seek for "reservoirs of group B" elsewhere than among the Bhils. The large amount of B among the Bhils living in the hilly

parts of north-west Hyderabad State, may be due to "inbreeding in an isolated community where one fertile family may have a large effect", as has been suggested by Macfarlane herself in the case of the Paniyans who showed 62·4 p.c. A and 7·6 p.c. B only.[6]

Guha, as we have already referred to above, found close connection between the Chenchus and the Bhils.[1] Photographs of Bhils and Chenchus published by Macfarlane[2] do not show such relationship. The Bhil type was represented by an old man and the Chenchus by a much younger person and comparison is indeed difficult for obvious reasons. As Dr. Guha's data on the Bhils are still unpublished we cannot discuss them. From what we have seen of the Bhils, I think the Bhils of Gujarat do not belong to any aboriginal stock we know of in India. In blood groups, the Bhils do not approximate to any aboriginal group either pure-bred or hybrid. I should think that the time has come when we should revise our entire ethnological nomenclature. The classification of the Bhils with the Kols and Sonthals, I think, has been more for symphony than for fundamental ethnic similarity; the name Bhil, as we are told, is derived from Tamil 'bil' or a bow which is the principal weapon of offence and defence of the Bhils. In ancient Tamil poetry "villavar" (bowmen) refers to the savages of pre-Dravidian stock. It may be that the Dravidian speaking races have given the Bhils their historic appellation on account of the popular use they make of bow and arrows.

The blood groups of the Bhils of the Hyderabad State (Macfarlane) are found to differ from those obtained by me in Gujarat. If the Bhils of Gujarat are racially different from those of the Hyderabad State, then this disparity can be accounted for. Otherwise we have to attribute the disparity to the nature of the samples investigated. As all precautions were taken to render the result free from any technical or methodological defects, the size of the samples may have something to do with this disparity. Unless the size of the samples is statistically significant, conclusions based on them must be regarded as unsafe. Although the standard size of blood group samples has not been agreed upon, it is necessary to exercise some caution in interpreting results. The table below will illustrate the point.

Tribe or Caste	0	A	B	AB
Bhils (Macfarlane) (44) *J.R.A.S.B.* ..	31·8	13·6	52·3	2·3
Bhils (Macfarlane) (140) *Am. J. Phy. Anth.* ..	18·6	23·6	41·4	16·4
Bhils (Majumdar) (369) ..	37·5	27·5	26·0	9·0

[1] Guha, B. S., *The Racial Affinities of the Peoples of India*, 1935, **1**, Pt. 3, Calcutta.

[2] Macfarlane, E. W. E., "Blood grouping in the Deccan and Eastern Ghats," *J.R.A.S.B.*, 1940, **6**, No. 5, Pt. 39–49.

[3] Macfarlane and Sarkar, "Blood Groups in India," *American Journal of Physical Anthropology*, December 1941, **28**, No. 4.

[4] Majumdar, D. N., "The Blood Groups of the Criminal Tribes of the U.P.," *Science and Culture*, 1942, **7**, No. 7.

"The Blood Groups of the Doms," *Curr. Sci.*, April 1942, **10**, No. 4.

[5] Shah, P. G., "Non-Hindu Elements in the Culture of the Bhils of Gujarat." *Essays in Anthropology Presented to S. C. Roy.* Maxwell Co., Lucknow.

[6] Aiyappan, A., "Blood Groups of the Pre-Dravidians of the Wynad Plateau," *Curr. Sci.*, 1936, **4**, 493–4.

CHRONICA BOTANICA

An extensive list of Institutions, Societies and Research Workers in the pure and applied plant sciences in C. and S. America has been prepared by the Editors of *Chronica Botanica*, in co-operation with the Division of Agriculture of the Office of the Co-ordinator of Inter-American Affairs, Washington, D.C. It has been published in *Chronica Botanica*, Vol. 7, Nos. 2 and 3 (March and May 1942).

SCIENCE AND ART

BY

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ALL good science must exhibit a certain amount of artistry and all good art must essentially satisfy certain scientific requirements. It is proposed to discuss broadly the relation of Geometry and Mechanics to Art.

Art begins with drawing inasmuch as Art comprises representation on material objects of some æsthetic subject, real or imagined. By the very definition of Geometry, all drawing is essentially geometrical in the wider sense; Geometry being the study of shape and size, a mathematical method to scrutinize the shapes and sizes of isolates of Nature as perceived by the senses and conveyed to the mind. Persistent use of this method may have the tendency to make it a "second nature" of the mind which will then be incapable of judging whether the impression it has gathered has any independent existence in Nature, whether the regularity of shapes in the Universe is its intrinsic quality or whether the regularity is only a creation of mental imagination due to the geometrical method employed. (We are, of course, not alluding here to the Pure Mathematician who deals with imagined systems such as n-dimensional geometry; to that extent pure mathematics is just a thought rather than a science.) The Artist does not suffer from geometrical thinking because unlike the geometer he eliminates the method of logical deduction and is concerned only with the æsthetic impression that shape and size create on his mind. In his detachment from geometrical methods, he draws more on his own imagination and feeling than on the actualities of Nature. We do not class the photographer as an artist. The photographer is only a geometer. He uses a geometrical apparatus called a Camera and lets his lens do the work which the Artist would let his mind do. Let us now come to the scientist who deals with the particular branch of science which is called Mechanics. We shall call him the Mechanist. The Mechanist goes further than the geometer and studies the equilibrium of pieces of matter if at rest or their motion, if moving. But in spite of these differences in their outlook and methods, there is an essential unity of purpose among the Geometer, the Mechanist and the Artist, *viz.*, to extract and study isolates of Nature. Because of this unity of purpose the view-point of anyone of them has a certain effect on the others.

One such common characteristic is that even when the scientist and the Artist are studying the internal properties of an isolate of nature, they cannot forget the relation to the external world.

For instance, take the case of the Geometer. He commences with his points, lines, and circles and with the help of axioms and logical analysis lays down qualities of the grouping known as "properties" of one or the other of the constituents. But a point as an abstraction or a perfect isolate with nothing else in the picture has no meaning for him at all. It has no "properties". He cannot even say that "it has position but no magnitude," because unless he compared it with some other entity he could not define "position" or magnitude. Magnitude must be in terms of some unit. So also a circle isolated from the rest of the Universe is meaningless. Having no relationship to anything it cannot be interpreted. It is only when the point or the circle is associated with other entities such as lines, chords, tangents, etc., that they have qualities. It is only then that they have a "geometry".

The Mechanist is in the same situation. He takes out a chunk of Nature so to speak and studies its motions and equilibrium in any set of circumstances he wishes to analyse. He then tries to piece these together in a logical way starting from certain laws of nature which he formulates having discovered their universality. He isolates from Nature what he himself experiences, *viz.*, mass, inertia, and force. He knows that force is necessary to change the state of motion of a piece of matter. In other words mass has inertia. By his studies, he can even predict the position of heavenly bodies at any future time. Like the Geometer he is interested in shape and size also because these affect the motions of bodies. But there is a difference. The Geometer is concerned only with the shape and size of the

constituents of the group. He is not interested how the whole group is situated. For instance to the Geometer it may not matter whether an egg is placed on a table on its end or its side. He is concerned with the oval shape only and the properties say of its chords and tangents, etc. To the Mechanist the distinction is vital for on it depends whether the egg will stand or fall or if disturbed from its position will break or not. He is concerned with the Statics and Dynamics of the circumstance.

But consider the Artist. He also draws his stimulus from the world around him as do the Geometer and the Mechanist. He also takes extracts from the real continuum of existence. He is also concerned with form, movement, force and even mass, because equilibrium and balance are essential to æsthetics. His activities are however primarily social whilst those of the scientist are only in the narrower sense social in that they might provide material for the correct action to be taken for material prosperity of the Society. Like the Psychologist and the Sociologist the Artist focusses his art on the relation of man to his environment, on the activities, the joys, the sorrows that are stimulated in human beings by human beings and nature. In this sense he might depict in art the "spirit" of man. He might detach himself from his objectives and go to a higher level of abstraction but taken as a rational endeavour on his part, Art affects the emotional reaction of social beings with the rest of the human beings. The Artist is most concerned with the world around him. To this extent his work is drawn from the realities of Nature which the Scientist studies on logical basis. The novelty about his work is that he brings social appreciation to bear on his abstractions. Thus although in his work the detailed form may bear resemblance to Nature, the general form need not. The resemblance of the detailed form to Nature is essential to achieve interpretation. It is in this sense that the Artist cannot depart completely from qualities of a scientific nature. It is in this sense that all good science must exhibit a certain amount of artistry and all good art must satisfy certain scientific requirements. It is here that Science and Art are inter-connected.

Instances of such relations are numerous. It is an elementary result in statics that a triangle on a broad-base with its vertex within the base-line remains in stable equilibrium. The stability will suggest that it is devoid of movement. Hence the Pyramids of Egypt convey the idea of time-lessness and eternity. Hence also the teaching posture of Buddha in the Ajanta and Ellora rock-temples with its broad triangular outline with a broad base conveys Nirvana (Supreme Bliss) the eternal hope of man. An obtuse-angled triangle with a tilt forward depicts strain. A man dragging a load with a rope would form such a triangle with the load and the ground.

EXPLOSIVE RIVETS

A NEW use for aluminium is the manufacture of explosive rivets in which a charge of powder takes the place of a riveting hammer for expanding the driven end. The explosive rivet is specifically adapted to the fastening together of metal plates which are accessible only from one side, but will doubtless find much wider application.

The explosive rivet has a cavity in the aluminium shank in which is placed a small charge of a high explosive, which is set off when the rivet is heated up to a critical temperature. The heat necessary is furnished by a special riveting iron—a silver-tipped electrically heated tool held against the rivet head. In about 2 seconds the rivet is heated sufficiently to cause the necessary explosion, which expands the shank of the rivet in such a way as to fasten together securely the metal sheets. The rivets now being made are of aluminium alloy, only 1/8 in. diameter, but the development of larger rivets, up to 1/4 in. diameter is proceeding. They are supplied in the age-hardened condition and do not need the careful refrigeration following heat-treatment before use which is necessary with rivets of the same alloy that are used for ordinary clinching.—(*The Times, Trade and Engineering*, Vol. 50, Jan. 1942, p. 36.)

LETTERS TO THE EDITOR

STRUCTURE OF THE BAND SPECTRUM OF PHOSPHORUS AND NUCLEAR SPIN

THE band spectrum of phosphorus, as excited in a discharge tube has been photographed with a Hilger large Quartz Littrow Spectrograph and the bands (9, 21), (5, 21), (5, 18) and (4, 18) have been measured. The analysis of their rotational structure has led to the following values of the constants (in cm.$^{-1}$).

$$B'_4 = 0\cdot 2346 \qquad B''_{18} = 0\cdot 2799$$
$$B'_5 = 0\cdot 2323 \qquad B''_{21} = 0\cdot 2736$$
$$B'_9 = 0\cdot 2255$$

The constant for $v' = 9$ agrees with that obtained previously by Herzberg[1] and also by Ashley,[2] the others being newly obtained. The absence of any perturbations in the rotational structure of the bands (5, 21) and (5, 18) has shown that the perturbations pointed by Herzberg must be only vibrational.

Elaborate quantitative measurements have also been made of the alternating intensities of the rotational structure lines in the case of the bands (5, 21), (5, 18), (6, 22) and (9, 21). The (5, 21) band alone gave an anomalous value 3·3, while for the others, the ratio, on an average, is 3·0. Such a high value (3·4 to 3·5) was obtained for this band also by Jenkins.[3] But the anomaly cannot be ascribed to any effect of perturbations as the (5, 18) band does not show the anomaly and the rotational structure has not revealed any perturbations. The high value is shown to arise from superposition by a faint band.

The intensity ratio leads to a value of $\frac{1}{2}\frac{h}{2\pi}$ for the nuclear spin of phosphorus, as determined by Ashley and Jenkins. Details of the results will be published elsewhere.

K. NARAHARI RAO.

Solar Physics Observatory,
Kodaikanal,
August 30, 1942.

1 *Ann. d. Physik*, 1932, **15**, 677.
2 *Phy. Rev.*, 1933, **44**, 919.
3 *Ibid.*, 1935, **47**, 783. (Letter).

A PRELIMINARY NOTE ON THE INCIDENCE AND CAUSATION OF GLYCOSURIA IN PREGNANCY

ABOUT three hundred pregnant women attending the ante-natal clinic of the Bai Jerbai Wadia Maternity Hospital, Parel, Bombay, were examined. Their diet, as far as it could be gathered from personal history, was in most cases lacking in milk, fruits and green vegetables. The cereal consumed consisted almost exclusively of rice. Glucose was found to be present in the urine of about 30 per cent. of the subjects during the 7th, 8th and 9th months of pregnancy. Glucose tolerance tests of these

glycosuria cases indicated that 99 per cent. were cases of Renal Glycosuria and 1 per cent. of Pancreatic Glycosuria. These Renal Glycosuria cases revealed a low Ca and Vitamin C content in blood although the non-protein nitrogen content was normal. In these cases the percentage of urea in the urine was also found to be within the average normal limits. Administration of suitable doses of calcium and Vitamin C caused a disappearance of glucose from the urine.

Further investigations are in progress.

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Bombay,
September 2, 1942.

BACTERIOLOGICAL EXAMINATION OF BLOOD, STOOLS AND URINE OF SUSPECTED CASES OF TYPHOID FEVER*

IN the course of an epidemiological investigation of typhoid fever in Bangalore City, an examination of the blood, stools and urine in such of those cases where the diagnosis was inconclusive has been carried out. Whole blood was cultured only in those cases that were traced in the first or second week of infection; in the other cases culture of the stools, urine, the widal test and clot cultures were done.

Salenite. F. was used as a primary enrichment media for the typhoid group of organisms, the stools and urine being directly inoculated on this media in the field before being sent to the laboratory. Brilliant green bile broth, eosin-methylene blue and Wilson and Blair (Difco Company) were adopted for the final isolation of the organisms.

Blood Culture.—Seventy-eight samples of blood were examined as given in Table I.

Table I shows that in the 16 samples taken in the second week of infection from patients clinically diagnosed as typhoid, the blood culture was positive in 9 or, 52·2 per cent. of the cases. The remaining 3 samples taken in the third week were negative. Of these 9 positive cultures, 6 were positive for *B. typhosus*, 3 for *B. para-typhosus A*, and none for *B. para-typhosus B*.

It may be noted that out of these 9 positives 4 samples had been obtained from those who had developed the infection after inoculation with T.A.B. vaccine, and one from a patient

TABLE I

Bacteriological and Serological Analysis of Blood

Nature of Culture	Total Number Examined	Clinically diagnosed as typhoid	Clinically Definite Cases Days after Onset								Number Positive		
			0—7 days		7—14 days		14—21 days		After 21 days				
			Specimens	No. Pos.	Specimens	No. Pos.	Specimens	No. Pos.	Specimens	No. Pos.	T	A	B
Whole Blood Culture	29	19	0	0	16	9	3	0	0	0	6	3	—
Clot Culture	9	6	0	0	1	0	2	0	3	0	—	—	—
Widal	40	25	1	1	16	14	3	1	5	5	17	—	4†

† Positive also for *B. typhosus*.

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* The auther is grateful to the Director of Public Health, the Health Officer, Bangalore City, the Medical Officers of the Victoria and Vani Vilas Hospitals and to the Superintendent, Bureau of Epidemiology, for valuable help rendered by them during the course of this investigation.

who was having a second attack of typhoid in 1938 (the first attack being in 1936). In all these cases since the widal test by itself was of no diagnostic significance, culture of the whole blood was of special value in establishing a definite diagnosis of typhoid.

Clot Culture.—Of the 9 samples examined 6 were clinically diagnosed as typhoid. One clot culture was made in the second week, 2 in the third week and 3 in the fourth week. All these clot cultures gave negative results.

Widal Test.—This was carried out on 40 samples of blood, 25 of which were clinically cases of typhoid. Of these 17 were positive for *B. typhosus* and 4 both for *B. typhosus* and *B. para-typhosus B.*

In cases clinically diagnosed as pneumonia, malaria, tumour of the brain, pulmonary or abdominal tuberculosis, or some allied disease, the widal was definitely positive particularly for the para-typhoid group of organisms. In none of these cases was there any history of the patient having suffered from typhoid at any time before or having been recently inoculated with T.A.B. vaccine. In a place like Bangalore where typhoid infection has been prevalent for many years it is likely that a large proportion of the population have suffered from comparatively mild infections as a result of which their blood would contain the specific typhoid agglutinins.

When such people get high fever due to causes other than typhoid, owing to anamnestic reaction, the titre for typhoid group of organisms possibly shoots up so high that we get positive widal in diagnostis titres. It seems therefore, necessary to determine what the natural level of agglutinins for the typhoid group of organisms is amongst random samples of the population in Bangalore City before fixing up the titre for diagnostic purposes. For instance in Bombay City, on the basis of such an investigation minimum titre for diagnostic purpose has been fixed up for *B. typhosus* as 1-250 (formalised suspension) and 1-125 for H. agglutination; for Para A and B infection the titre fixed up is 1 : 25.

Stool Culture.—Of the 103 samples cultured, in seven cases, the specimens from the same patient had been examined twice at a week's or fortnight's interval. The bacteriological analysis of the remaining 96 samples is given in Table II.

TABLE II

Bacteriological Analysis of Stools and Urine

Specimen	Total No.	Clinically diagnosed as typhoid	Days after Onset in Clinically Definite Cases								Positive Biochemically and Serologically				Positive only Biochemically			
			0—7 days		7—14 days		14—21 days		After 21 days									
			No. Exam	No. Pos.	No. Exam.	No. Pos.	No. Exam.	No. Pos.	No. Exam.	No. Pos.	T	A	B	Total	T	A	B	Total
Stools	96	65	1	0	26	14	24	9	14	9	17	2	2	21	5	1	5	11
Urine	48	42	1	0	23	4	9	4	9	0	6	—	—	6	2	—	—	2

Of the specimens of stools cultured from 65 clinically definite cases, 17 proved positive for *B. typhosus*, 2 for *B. para-typhosus A* and 2 for *B. para-typhosus B*. In these cases, in addition to getting typical biochemical reactions, the isolated culture was agglutinable by the specific standard high titre sera and in six cases by the patient's serum also. In 11 cases, however, the isolated culture gave typical biochemical reaction but was not agglutinable by the specific high titre sera.

In a few clinically typical cases of typhoid fever, in which the typhoid group of organisms could not be isolated on culture of the stools, blood or urine, some of the non-typhoid group

of organisms like *Proteus morgani, Pseudomonas pyocyaneus, Bacterium faecolis alkaligenes,* and a few other strains with a typical biochemical or serological reactions were isolated. The possible association of these organisms in the causation of continuous fever required further investigation.

Urine Culture.—During the investigation 50 samples of urine from cases of continuous fever were cultured. Out of these, in two cases the same specimen was examined twice at about a week's interval. The results of analysis of the remaining 48 samples are given in Table II.

Out of clinically definite cases of typhoid, *B. typhosus* was isolated in 6 cases, the paratyphoid group of organisms not being isolated in any of them.

V. N. MOORTHY.

Department of Public Health,
Bangalore,
August 15, 1942.

THE FATTY OIL FROM THE SEEDS OF *MALLOTUS PHILIPPINENSIS*, MUELL. ARG. (NATURAL ORDER EUPHORBIACEÆ)

THE seeds of *Mallotus philippinensis* (commonly known as *Monkey face tree* in English and *Kamala* in Hindustani) on extraction with benzene yielded a thick, transparent light brown oil of drying character. The physical and chemical constants of this oil, which has not so far been investigated,[1] have been determined with the following results:—

Yield of oil in kernels—48·8 per cent.; Specific gravity at 33° C./33° C.—0·9333; Refractive index at 34° C.—1·5156; Acid value—11·3; Saponification value—207·6; Iodine value—157·3; Acetyl value—46·8; Hehner value—96·1; Unsaponifiable matter—1·9 per cent.

A detailed examination of the constituent acids of this oil is now in progress.

BAWA KARTAR SINGH.
BRIJMOHAN SARAN.

Chemistry Department,
University of Allahabad,
August 4, 1942.

1 Brodie, N., *Bull. Indian Ind. Research*, No. 10, "Indian Vegetable Oils", 1937, p. 33.

CONSTITUTION OF HIBISCETIN

THE hydroxy flavonol, hibiscetin obtained from the flowers of *Hibiscus sabdariffa,* was shown to be 3 : 5 : 7 : 8 : 3′ : 4′ : 5′-heptahydroxy flavone from a study of its reactions and of the degradation products.[1] This structure has now been confirmed by the synthesis of its methyl ether according to the method of Allan and Robinson.[2] 2 : 4-dihydroxy-ω : 3 : 6-trimethoxy acetophenone has been condensed with trimethyl gallic anhydride and anhydrous sodium trimethyl gallate to produce 7-hydroxy-3 : 5 : 8 : 3′ : 4′ : 5′-hexamethoxy flavone, which on subsequent methylation has yielded 3 : 5 : 7 : 8 : 3′ : 4′ : 5′-heptamethoxy flavone. This methyl ether agrees in all respects with heptamethyl hibiscetin. Experiments on demethylation to yield hibiscetin itself have yet to be carried out.

P. SURYAPRAKASA RAO.

Andhra University,
Guntur,
August 5, 1942.

1 Suryaprakasa Rao and Seshadri, *Proc. Ind. Acad. Sci.* (A), 1942, **15**, 148.

2 Allan and Robinson, *J.C.S.*, 1924, 2192.

PHENYLHYDRAZINE ANÆMIA IN RATS

IN the search for a simple method for making experimental animals anæmic for the study of the hæmopoietic action of amino-acids, it was decided to investigate the possibility of using phenylhydrazine. This substance has long been known to have a destructive action on the red blood cells, a fact which has found therapeutic application in the treatment of polycethemia vera, a disorder in which the blood contains an abnormally high proportion of erythrocytes. Apart from ascertaining the conditions under which experimental anæmia could be induced in rats by injection of phenylhydrazine it was found necessary to study the blood picture of such animals in some detail as certain authors claim to have observed an increase in blood concentration due to fluid loss in poisoning by hydrazine and its derivatives [*cf.* Underhill and Karelitz[1] (1923), Bondansky[2] (1924)]. In careful experiments on rabbits

carried out by Long[3] (1925-1926) no such anhydremia was, however, observed.

For experiment, rats weighing about 80 gm. and maintained on a synthetic diet consisting of starch, sugar, casein, butter-fat and salt mixture with supplements of yeast and codliver oil were used. It was found that the animals could be consistently made anæmic by a single intraperitonial injection of 2 mg. (1 c.c. of a 0·2 per cent. aqueous solution) of phenylhydrazine. Commencing from a control period of three days prior to the injection daily determinations were made of the red cell count, hæmoglobin and of reticulocytes until the blood characteristics returned to normal. In view of the claims regarding anhydremia mentioned in the literature two independent methods were used for hæmoglobin determination, *viz.*, the Iron method of Wong[4] (1928) and the Acid Hæmetin method as described in Peters and Van Slyke[5] (1932). The two methods gave results in close agreement The experiments were repeated on several groups of animals, the results on one set of eight rats being given in the accompanying tables. The average values obtained with this group were used for the construction of the graph.

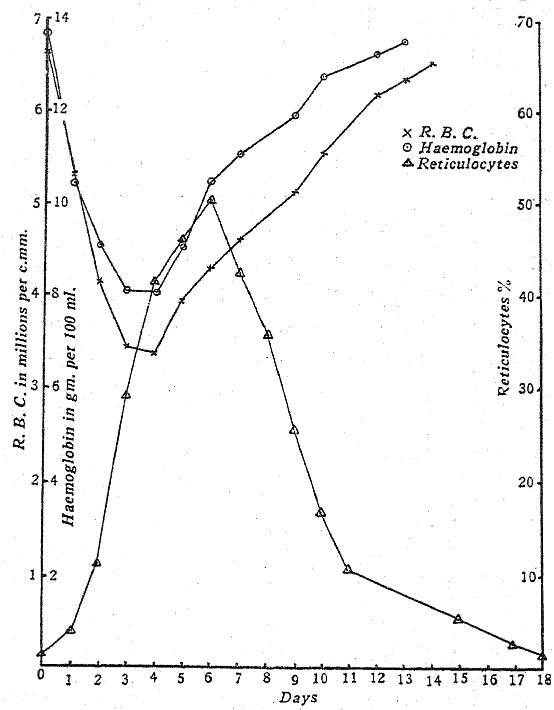

Fig. 1

Table I

R.B.C. in million per c.mm.

Rat No.	Days after injection														
	0*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	6·60	5·33	4·30	3·48	3·40	3·77	4·30	4·60		5·10	5·64		6·38	6·64	6·60
2	6·31	5·51	4·10	3·49	3·48	4·01	4·37	4·71		5·31	5·67		6·20	6·40	6·45
3	6·51	5·60	4·34	4·47	3·46	4·04	4·22	4·51		5·02	5·73		6·21	6·35	6·50
4	6·50	5·31	4·40	3·57	3·43	3·88	4·37	4·80		5·12	5·69		6·30	6·21	6·40
5	6·98	5·10	4·03	3·52	3·50	4·00	4·34	4·70		5·31	5·73		6·45	6·95	6·90
6	6·99	5·01	4·10	3·28	3·03	4·04	4·37	4·50		5·01	5·35		5·95	6·01	6·61
7	6·99	5·25	4·19	3·34	3·41	3·80	4·03	4·20		5·00	5·36		6·01	6·20	6·50
8	6·13	5·01	4·01	3·27	3·29	3·93	4·41	4·76		5·10	5·33		6·00	6·15	6·19
Average Values	6·63	5·30	4·18	3·43	3·38	3·93	4·30	4·60		5·12	5·56		6·19	6·36	6·52

* Averages of 3 days previous to injection.

TABLE II

Gm. Hæmoglobin per 100 c.c. blood (acid hematin method)

Rat No.	Days after injection											
	0*	1	2	3	4	5	6	7	9	10	12	13
1	14·33	10·68	8·93	8·10	8·01	8·80	10·17	11·24	12·22	13·64	13·90	14·10
2	13·28	10·35	8·77	8·28	8·20	9·22	10·70	11·11	12·00	12·64	13·64	13·60
3	14·61	10·91	9·21	8·31	8·10	9·83	11·03	11·19	11·75	12·64	13·50	14·01
4	13·77	11·11	9·88	8·33	8·31	9·43	10·91	11·11	12·00	12·50	13·43	13·50
5	13·53	10·35	8·83	8·21	8·12	8·82	10·70	11·75	12·60	13·64	13·71	13·76
6	13·45	10·76	9·09	7·89	8·00	8·52	9·83	10·53	11·53	11·90	12·50	13·20
7	13·69	10·00	9·14	8·10	7·99	8·82	10·35	10·64	11·53	-	13·04	13·50
8	12·77	10·17	8·99	7·84	8·00	8·69	10·00	10·71	11·80	12·50	12·40	12·60
Average Values	13·68	10·42	9·11	8·13	8·09	9·02	10·46	11·04	11·93	12·78	13·27	13·53

* Averages of 3 days previous to injection.

TABLE III

Reticulocytes (%)

Rat No.	Days after injection														
	0*	1	2	3	4	5	6	7	8	9	10	11	15	17	18
1	1·15	3·80	10·30	28·60	41·00	45·00	51·40	42·40	34·40	26·00	17·60	10·80	5·30	3·00	1·50
2	·95	3·40	12·00	30·30	41·00	46·00	48·90	43·00	36·10	25·60	16·40	11·00	5·00	2·60	1·20
3	1·00	3·60	10·80	27·80	39·00	46·00	48·80	44·60	36·80	26·00	15·80	10·60	5·80	3·10	1·00
4	1·15	4·00	11·20	29·60	39·90	45·80	49·80	43·80	34·60	25·40	17·60	11·40	6·00	2·20	1·10
5	·95	3·70	10·60	30·40	40·80	46·20	51·40	42·90	35·80	24·10	15·90	10·80	6·10	2·40	1·40
6	·90	4·20	11·00	29·40	42·00	46·40	50·00	40·40	36·80	25·80	15·90	11·10	5·20	2·80	1·80
7	1·05	4·30	11·30	28·80	41·20	45·00	51·40	42·60	38·20	27·00	18·00	10·20	6·30	3·00	1·00
8	1·05	4·60	12·70	30·00	41·40	46·80	52·00	42·00	34·20	26·10	17·20	11·40	6·10	3·10	1·60
Average Values	1·03	3·95	11·25	29·31	41·41	45·90	50·40	42·71	35·86	25·74	16·80	10·91	5·73	2·77	1·32

* Averages of 3 days previous to injection.

It will be seen from Tables I to III and Fig. 1 that the anæmia runs a well-defined and reproducible course in all the animals manifesting itself in a lowered erythrocyte and hæmoglobin content within 24 hours after injection. The decrease in hæmoglobin and R.B.C. follow a parallel course, both reaching their minimal values (about 60 and 50 per cent. of normal respectively) between the third and the fourth day after injection and both being restored to normal on the thirteenth or fourteenth day. With the fall in erythrocytes, there is an increase in the number of reticulocytes which reaches its maximum value of about 50 per cent. on the sixth day. After this there is a gradual fall in their number until the normal value of about 1·1 per cent. is reached at the end of 18 days. During the experimental period the animals maintained their normal health and increase in weight. Nor were any ill-effects discernible if animals after recovery from the anæmia were subjected to a second treatment with phenylhydrazine.

These experiments make it clear that injection of phenylhydrazine provides a simple and convenient method of making experimental animals anæmic for the study of the action of hæmopoietic substances.

The author is very much indebted to Professor M. Damodaran for his valuable advice and help.

K. M. Yeshoda.
University Biochemical Laboratory,
Madras,
August 21, 1942.

1 Underhill and Karelitz, *J.B.C.*, 1923, **58**, 147–51.
2 Bodansky, *J. of Pharmacology*, 1924, **23**, 127–33.
3 Long, *J. of Clin. Invest.*, 1925–26, **2**, 329.
4 Wong, *J.B.C.*, 1928, **77**, 409.
5 Peters and Van Slyke, *Quantitative Clinical Chemistry*, 1932, **2**, 668.

OLPIDIUM UREDINIS PARASITIC WITHIN THE UREDIOSPORES OF *HEMILEIA CANTHII* BERK. AND BROOME

The genus *Olpidium* founded by Schröter includes many species which are parasitic within the tissues of plants. *Olpidium Brassicæ* (Woro.) Dang. and *O. Viciæ* Kusano cause diseases of cabbage and *Vicia* respectively, particularly the former causes the damping off disease of the cabbage seedlings. *O. pendulum* Zopf is found parasitic within the pollen of aquatic plants. Other species of *Olpidium* are found parasitic within the mycelium of *Saprolegnia*, algal filaments and others.

Olpidium uredinis (Lagerh.) Fischer is known to be hyperparasitic within the urediospores of many rusts, such as *Uredo airæ*, *Puccinia violæ*, *Puccinia rhamni*[1] and those of *Puccinia coronata* and *P. levis*.[2] In the course of the studies on some of the uredinicolous fungi, the writer observed that many of the urediospores of *Hemileia canthii* Berk. and Broome being hyperparasitised by *Olpidium uredinis*. Collection of the material was made near Talakad, Mysore State. The affected spores are without any cell contents and fail to germinate when placed in moist chambers. The sporangium of the hyperparasite is single-celled (Fig. 1), hyaline, ovate or spherical. As many as nine such sporangia have been noticed within a single urediospore. The

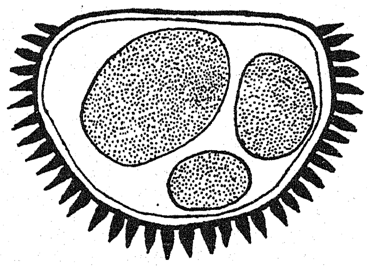

Fig. 1

Urediospore of *Hemileia canthii* parasitised by *Olpidium uredinis*.. × 1800.

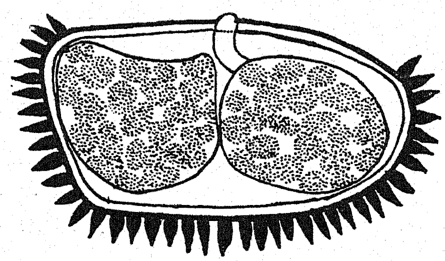

Fig. 2

Formation of zoosporangium, × 1800,

division of the centents of the sporangium into zoospores takes place (Figs. 2 and 3). In one instance the formation of the exit tube which pierces through the wall of the urediospore was observed (Fig. 2). The hypnospore can be differentiated from the sporangium by its

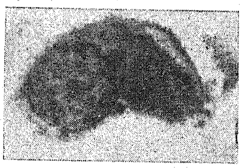

FIG. 3

Photomicrograph of urediospore showing the sporangia of *Oplidium uredinis*.

thick wall, the exospore being smooth and hyaline.

M. J. THIRUMALACHAR.

Department of Botany,
Central College,
Bangalore,
August 2, 1942.

[1] Fischer, A., Phycomycetes in Rabenhorst's *Kryptogamen Flora*, 1892, 2 Aufl., Leipzig, Bd. 1.
[2] Arthur, J. C., *The Plant Rusts*, (Uredinales), 1929.

A NOTE ON THE RAINFALL AT MADRAS AND BANGALORE

THOUGH Madras and Bangalore are on very nearly the same latitude, the difference between their heights and the distances from the sea, affect the distribution of rainfall in a characteristic way. September is the wettest month in Bangalore while in Madras, November is the corresponding month. January is the driest month in Bangalore and February in Madras. The number of rainy days is very nearly the same, *viz.*, 57·7 for Bangalore and 57·2 for Madras; but the average annual rainfall at Bangalore is 36·05″ only while at Madras it is 49·57″; thus on an average more rain falls at Madras than at Bangalore on a rainy day. Madras gets in the North-East Monsoon 63 per cent. of the annual total while Bangalore gets only 25 per cent., and Bangalore gets 56 per cent. of the annual total in the South-West Monsoon while Madras gets only 31 per cent.

When hourly distribution of rainfall is considered the following interesting details are noticed. If the day is divided into periods of six hours, it is found that at Bangalore the period 6 p.m. to midnight is the wettest part of the day in all the seasons and 6 a.m. to noon, the driest. Madras resembles Bangalore only during the South-West Monsoon; in summer 6 a.m. to noon is the most rainy period and 6 p.m. to midnight the driest period while during the North-East Monsoon season midnight to 6 a.m. is the wettest period and noon to 6 p.m. the driest period. The difference is probably due to conditions of instability developing over land masses towards the evening and early hours of the night and over the sea towards late hours of the night and early hours of the morning.

It is also found that rainfall per rain-hour at Madras is generally greater than at Bangalore in all the seasons.

C. SESHACHAR.

Central Observatory,
Bangalore,
August 20, 1942.

THE VERTICAL AND HORIZONTAL SHRINKAGE OF BLACK COTTON SOIL AT MANDALAY, BURMA

WHILST investigating the cause of the excessive and continual warping and cracking of buildings constructed in Mandalay, Burma, an endeavour has been made to trace the Clarke* buckling effect of the substrata during expansion and contraction of the clay under variations in moisture content.

Mandalay soil resembles a black cotton soil, and is slightly calcarious and alkaline. It possesses a massive† columnar structure and it was, therefore, thought that vertical and horizontal contraction of the natural elements during drying might be unequal and hence ultimately

TABLE I

Showing percentage contraction and loss of moisture of samples collected from building compounds on drying from their natural moisture content

SITE	Original moisture content% dry wt.	Moisture content after "air drying" at app. 50% R.H.	Lineal shrinkage % (Average of 12 readings)		Ratio of horizontal to vertical shrinkage
			Horizontal	Vertical	
1. Provincial Police Training School ..	8·07	5·81	2·10	2·09	1·01
2. District and Sessions Judge's Quarters ..	11·81	5·79	2·52	1·45	1·75
3. Office of the S.D.O., P.W.D. ..	11·20	5·59	3·13	2·62	1·16
4. Office of the Deputy Director of Agriculture	9·96	3·95	1·64	1·54	1·07

TABLE II

Showing percentage contraction and loss of noisture of samples collected from building compounds on drying after artificial in situ *watering*

1. Provincial Police Training School ..	14·28	6·11	2·66	2·29	1·16
2. District and Session Judge's Quarters ..	17·34	6·30	4·87	4·80	1·02
3. Office of the S.D.O., P.W.D. ..	21·57	5·28	2·09	1·59	1·31
4. Office of the Deputy Director of Agriculture	16·75	4·63	2·37	2·16	1·10

lead to the buckling of the soil and help to explain the dynamic sinusoidal curves of building deflection.

To test this, approximately 6″ soil cubes were extracted from four different places, from one to two miles apart, and from a depth of 1½′ to 2′. From each site cubes were taken at two different moisture contents—at the dry weather natural moisture content and at a higher moisture content after artificially watering the soil *in situ*.

As the cubes dried the vertical and horizontal contractions were measured from the variation in the distance between pins placed, in each of the four vertical faces of the cube, at approximately 10 cm. apart. Each measurement reported below is a mean of 12 lineal measurements. In future work some more accurate method of measurement is necessary.

Notes.—At District and Session Judge's quarters:—Approximate clay content 60·0 per cent; colloidal clay 49·0 per cent.; S/R 2·68. Approximate replaceable bases:—
CaO, — 24·75 m.e./100 gm. air dry soil; MgO, 17·50 m.e./100 gm. air dry soil; Na_2O, 2·25 m.e./100 gm. air dry soil; K_2O, 0·28/100 gm. air dry soil.

Although the data given are not very conclusive and contain some anomalies, it nevertheless appears that there is a tendency for the horizontal contraction to exceed the vertical contraction.

As the replaceable bases vary considerably in the black cotton soil, future work on similar

soils, should include for testing predominantly monionic Na and Mg samples.

A. T. SEN.
F. L. D. WOOLTORTON.

Dacca University,
Ramna, Dacca,
September 20, 1940.

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* G. R. Clarke, *The Study of Soil in the Field*, 1938, p. 93, Clarendon Press.

† Massive columnar structure of approximately hexagonal figures, about 4′ in diameter, is formed in dry weather but strictly speaking there is no obvious macro-structure.

VELOCITY OF LONGITUDINAL TRANSPORT AND TRANSEVERSE TRANSLOCATION OF ROOT-FORMING HORMONE IN IMPATIENS

IN continuation of our work[1] on induced root formation in Impatiens, we have found the rate of translocation of the internal hormone to be 1·8 mm./hr. at the apical region, 2·4 mm./hr. at the basal region and 2 mm./hr. throughout the stem. The above rates were calculated as follows:—

Lanolin paste of 1 per cent. β indol acetic acid was applied to similar plants at the apical, central and basal regions of the stem and the time of root formation and the distance from the leafy top to the region of application of the paste gave the required results.

Fig. 1 *a* shows the root induction by 1 per cent. β-indol acetic acid lanolin paste on the defoliated half of the split stem, thereby demonstrating that the internal hormone has been transversely transported across the stem below the split from the non-defoliated half of the split stem. Fig. 1 *b* shows a split plant which has been treated simultaneously on both halves with root formation on the foliated half of the stem only, thereby indicating that the internal hormone has been arrested on the foliated half and consequently inhibiting root formation on the defoliated half. Application of the paste to a completely defoliated stem but supplied with solutions of sugars and vitamin B_1, does not induce root formation which again indicates that the defoliation has rendered the stem devoid of the natural internal hormone.

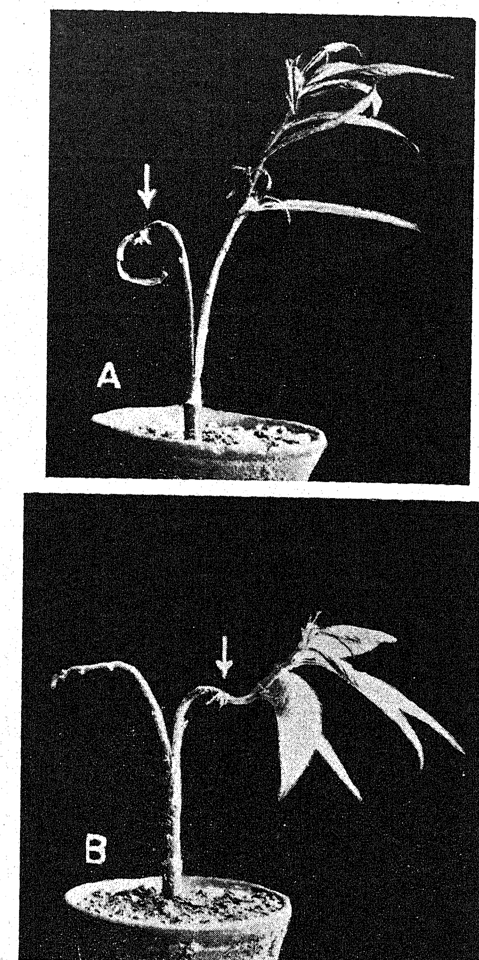

FIG. 1

Rooting responses in split stems of Impatiens

A, defoliated side treated with 1% indole acetic acid (note root formation on the defoliated side indicated by arrow). *B*, defoliated and leafy sides both treated with 1% indole acetic acid (note root formation only on the leafy side indicated by arrow).

The detailed paper will be published in the *Transactions of the Bose Research Institute.*

B. K. DUTT.
A. GUHA THAKURTA.

Bose Research Institute,
Calcutta,
July 29, 1942.

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1 Dutt, B. K., and Guha Thakurta, A, *Trans. Bose Res. Inst.*, 1939–41, **14**, 73–89.

A METHOD OF SECTIONING THE GAMETOPHYTES OF SOME LIVERWORTS AND PTERIDOPHYTES

CONSIDERABLE difficulty is often experienced in cutting smooth sections of many terrestrial and sub-terranean gametophytes. The following method was evolved to overcome this difficulty:—

(1) Fix the material in Formalin-acetic-alcohol or Nawashin's fluid. Wash with 50 per cent. alcohol in the former case and water in the latter.

(2) Run up to 70 per cent. alcohol and remove as much of the sand as is conveniently possible by means of a camel-hair brush.

(3) Treat with 5 per cent. HF in 70 per cent. alcohol—3 to 5 days—keeping the material in specimen tubes having a thick coating of paraffin on the inside. This is done simply by dipping the vial 2 to 3 times in melted paraffin and pouring it out.

(4) Wash out HF by repeated changes with 70 per cent. alcohol.

(5) Run up through the alcohol and xylol series and imbed in paraffin as usual.

(6) Soak the blocks in water for a week and cut at desired thickness—6 microns or above.

The cell structure was not damaged in any way for morphological or embryological studies. Good staining was obtained with both Safranin-Fast Green and Iron-Hæmatoxylin. The HF merely dissolves the finer sand particles that persist after the preliminary cleaning in step 2.

It is hoped that other botanists will try this method and report if cytological details are appreciably affected by the action of HF.

I am greatly indebted to my teacher, Dr. P. Maheshwari, who suggested the method for a trial.

BALWANT SINGH.

Biology Department,
Dacca University,
August 11, 1942.

BITTER PRINCIPLES OF THE NEEM OIL

IN connection with the note on this subject by Siddiqui, recently published in *Current Science*,[1] attention may be drawn to a paper with the above title published in the *Indian Journal of Pharmacy* by Murti, Rangaswami and Seshadri[2] in October 1940. This paper seems to have escaped the notice of the author of the note in *Current Science*. In it, Murti *et al.* have clearly anticipated the mild methods of continuous extraction with warm alcohol and fractional separation of the crude extract by the use of organic solvents and they have employed these methods in the examination of the oil and the oil-cake. The most important observation was regarding the nature of the solid deposit obtained by allowing the oil to stand for a long time. This contained all the quantity of the bitter principle originally present in the oil. It could be separated into two definite fractions A and B using benzene, and substances of the same characteristics were obtained from the three sources mentioned above, *viz.*, the oil, the oil-cake and the deposit. Though they could not be obtained in a crystalline form with well-defined melting points and hence could not be given definite names, they seemed to have constant composition and properties. They were both sulphur-free, non-glucosidal bitter substances devoid of any odour. They were insoluble in water, soluble in alcohol and had reducing properties. Substance A, which had the empirical formula $C_5H_7O_2$ was soluble in benzene, whereas B with the empirical formula $C_4H_7O_2$ was insoluble in that solvent. When tested on earthworms and fresh-water fish, they exhibited no toxic properties in a concentration of 1 in 1000.

The components now described by Siddiqui seem to be, in general, of the same nature as the substances A and B. The two minor components, nimbin and nimbinin, are described as being sulphur-free, neutral and water-insoluble just like A and B. There is, however, some difference since nimbin and nimbinin are said to be crystalline compounds with sharp melting points. Further, nimbin is

reported to have a higher carbon content, 66·6 per cent. as against 61·3 and 54·3 per cent. obtained for A and B respectively. The major bitter component nimbidin, however, is said to contain probably sulphur also and thus differs from substances A and B, though it is also amorphous. In the earlier work of Murti *et al.* it was stated that though the crude bitter solid contained sulphur, it disappeared in the course of purification and hence they felt that the sulphur-containing impurity was very small in amount.

It may perhaps be right to conclude that the bitter principles of neem oil are of complex nature and not unlike the active components of such well-known bitters as quassia and gentian.

S. Rangaswami.

Andhra University,
Located at Guntur,
August 5, 1942.

[1] Siddiqui, *Curr. Sci.*, 1942, **11**, 278.
[2] Murti, Rangaswami and Seshadri, *Ind. Jour. Phar.*, 1940, **2**, 206.

Omission of the reference is regretted. It was due to the fact that the paper in question was published in a recently started *Journal of Pharmacy* and came to my notice only through the chemical abstracts[1] after the publication of the note on the bitter principles of Neem oil. Due reference would have been made to the work in the detailed communication on the subject.

Extraction of Neem oil with alcohol and isolation of water insoluble, neutral and acid bitters from the alcoholic extract, with the help of dilute alcohol and other solvents, has been already referred to by Dymock.[2] The results obtained there or now by Seshadri *et al.* show the limitations of this mild method. The success of the procedure employed in the isolation of Nimbin and other products communicated in the note in *Current Science*[3] is demonstrated by the uniformity of the isolated products and their yields. The details of this process will be dealt with in a subsequent communication.

With regard to the substances A and B obtained by Seshadri *et al.*, it will be noted that they are amorphous powders which decompose at 115 and 110-115° respectively. B, moreover, melts at 72°, prior to decomposition at 110-115°. Nimbin and Nimbinin, which are definite crystalline substances melting at 205° and 192° respectively, cannot, therefore, be confused with either of them. As far comments on Nimbidine or on the relationship between the active components of Nim and gentian or other bitters, it will be more appropriate to discuss them at a later stage of the investigations, which are now in progress.

S. Siddiqui.

Laboratories of the Director,
Scientific and Industrial Research,
University Buildings,
Delhi,
September 19, 1942.

[1] *Ame. Chem. Soc. Abst.*, May 1942, p. 2685.
[2] *Pharmacographia India*, 1890, **1**, 327.
[3] *Curr. Sci.*, 1942, **11**, 278.

REVIEWS

The Photochemistry of Gases. By W. A. Noyes (Jr.) and P. A. Leighton. American Chemical Society, Monograph Series. (Reinhold Publishing Corporation, New York), 1941. Pp. 475. Price $10·00.

The mechanism of reactions in gaseous systems has not proved as simple as the pioneers in the field of chemical kinetics hoped. Energy of activation, chain reaction, accelerating and retarding influence of impurities, wall reactions—all these make difficut a correct interpretation of the course of a chemical process in homogeneous gaseous systems. Investigations during the last two decades have thrown considerable light on the subject, and we have now many well-established principles to guide us in this field.

The photochemistry of gases deals with a special branch of this subject where the atoms and molecules that start the reaction are activated by absorption of radiant energy. It is now clearly understood that semi-quantitative observations rarely supply data which are of much value in unravelling the hidden mechanism of a photochemical reaction. In Chapter II of the book, a clear exposition is given of the modern technique for experimental study of photochemical reactions. One cannot fail to be struck by the advance that has been made since the old days of Bunsen and Roscoe's actinometer. Chapter III deals with spectroscopy in relation to photochemistry. Spectroscopic study of many diatomic molecules has been rewarded with significant results. Energies of dissociaiton can now be calculated, and insight obtained into the states of the atoms formed by the dissociation of molecules. A photochemist must study absorption spectra, but unfortunately even now such studies tell him too little about the type of reaction which may be expected. Chapters IV and V deal with photochemical kinetics. The quantum theory provides a connection between energy absorbed and matter transformed, but its strict application is limited to a few simple reactions. The classic work of Polyani on chain reactions initiated by sodium atoms has motivated much of photochemical work in which the reaction is induced by photo-excited atoms. Thus reactions sensitized by mercury, zinc, and cadmium atoms have been exhaustively discussed. But as the authors point out, even the mechanism of the mercury sensitised hydrogen oxygen reaction is not known with certainty. Chapter VI deals with the photochemistry of gases involving absorption of radiation by diatomic molecules. Here the gaps in our knowledge are being continually narrowed down. But it still happens, that the experimental observations of one worker are not substantiated by another. Thus in the photobromination of double bonds, the authors take it for granted, that the concentration of the acceptor organic molecule has no influence on the velocity of reaction which is not confirmed by observations in the reviewer's laboratory. Where facts are disputed, there cannot be much unanimity of opinion as regards their interpretation. But that is the way that all progress is made!

The appendices contain a very valuable collection of all important references on the subject. The reactions have been classified and tabulated, and the probable absorbing molecules indicated in italics. Short remarks about the quantum yield and the mechanism of each reaction and a complete bibliography of authors are features which will be very welcome to those who are interested in the study of the subject.

The authors are to be congratulated on a balanced and up-to-date review of a subject which is rapidly growing in importance. What is more, they have indicated in many cases, the directions in which more accurate quantitative data are to be collected in order that a unique solution of a photochemical mechanism may become possible.

J. C. G.

A Short History of the Plant Sciences. By Howard S. Reed. (Waltham, Mass.: the Chronica Botanica Co.; Calcutta: Macmillan & Co., Ltd), 1942. Pp. 320, 37 Figs. $5.00.

"Work on the history of a subject is inevitably a reflection of the interest of the writer." Indeed, no botanist today can claim to keep abreast of the progress of the

plant sciences on all the expanding fronts. But in a book with this general title, even the warning uttered in the Preface fails to prepare the reader for the large gaps one actually finds. Here is a list of the subjects which the author leaves practically untouched: systematic botany (except in reference to the early systems of classification), phylogeny, genetics, plant breeding and evolution, palæobotany, the whole field of plant response, enzyme action and respiration, the water-soluble pigments, ecology, hormones, experimental morphology, forestry, vernalisation and the light requirements of plants. This is by no means a complete list,—and the book is intended for the guidance of the average graduate student in the universities.

These omissions would be considered serious enough to make the title of the book a misnomer, were it not that in the first half of the work the author traces the general trend of botany down to about the middle of the nineteenth century. In the second half the treatment is subject-wise and restricted to a few selected branches: gardens, plant geography, morphology, cytology, some aspects of metabolism, mycology and plant pathology. In these later chapters the emphasis is mainly upon recent work which in places is treated in far greater depth than the average graduate student would be able to fathom. The author too often retails a series of names and dates with brief statements of the results of individual investigations many of which, however important they may be as brick and mortar for building into the structure, by no means stand out as features in the edifice of botany. This mode of treatment is excellent for the specialist and research student; for the avowed purpose of this book it is disastrous.

In a short history of the plant sciences for the use of graduate students one expects a balanced and readable story of the main lines on which progress has been achieved during the centuries down to our own day. It would, therefore, have been preferable if the style of the first half of the work had been pursued to the end, indicating in broad sweeps how the last four or five decades have diverted enquiry into unexpected channels and opened up new vistas for research, transforming almost the whole trend of botany.

The first half of the book is distinctly better planned, and interestingly written. But in two fascinating chapters on the plant lore of the ancients, where Egypt and Assyria, Greece and Rome, China and early America are all adequately treated, one looks in vain for a bare mention of ancient India which was certainly well abreast of the times and gave much that the West has assimilated, though not always gracefully acknowledged. Through centuries of experience and cultivation the Hindus had accumulated a knowledge of plants, on the whole admittedly utilitarian but, even so, unsurpassed in their day; and they based upon it a system of dietetics and medicine which has stood the test of time. What Professor Reed calls, in Chapter IV, the Retrogressive Period was, of course, retrogressive only so far as the occidental nations were concerned. During this period, as he himself says, in China herbals and monographs of distinction were written, some of them comparing favourably with those of modern times. This period saw also the extraordinary spread of Muslim influence which preserved in translations much of what ancient Greece had discovered, developed and practised pharmacy to a high state of culture, and spread this knowledge into Europe itself. At Cordova the Moors laid out, as early as the 8th century, one of the oldest botanic gardens in the world. This same period also overlapped the heyday of Hindu civilisation when the Ayurvedic system of medicine was developed, from which numerous vegetable drugs indigenous to this country have been adopted by Western practitioners for centuries past. Is it fair to call this period a retrogressive period in the history of the plant sciences?

One cannot help feeling that the book, in spite of several useful features, suffers from a lack of proportion and of that width of outlook which should mark the responsible task of the historian.

The work is remarkably free from misprints, and several of the illustrations reproduced from classical works will enhance its interest. On page 150 a sentence in para 6 has been duplicated; on page 165, line 8, "Chrisman" should be "Christman".

B. Sahni.

The Cytoplasm of the Plant Cell. By A. Guilliermond. Authorized translation from the unpublished French MS. by Lenette Rogers Atkinson. Foreword by W. Seifriz. (Waltham, Mass: The Chronica Botanica Co.; Calcutta: Macmillan & Co., Ltd.), 1941. Pp. 247, 152 Figs. $4.75.

This important work, written by an acknowledged authority, summarises our knowledge of a subject which has undergone a remarkable development during the last thirty years, largely through the labours of the author himself and his school. As stated, the aim here is a morphological study of the cytoplasm, rather than an enquiry into the physiological activity of the cell: the latter aspect borders upon the domain of physical chemistry.

After a brief historical sketch of our knowledge of the cell, beginning with Robert Hooke's discovery of the honey-comb structure of cork, the author says that for solving the problem of cytoplasmic structure it is essential to employ the special mitochondrial technique (described on p. 57), supplemented by the use of the ultramicroscope and micromanipulator, vital staining and examination *in vivo*. Most ordinary fixing reagents, which contain alcohol and acetic acid, destroy the lipides of the chondriosomes and render these bodies invisible—a fact which explains why they had so long escaped observation except by a few cytologists.

A short chapter (II) defines the strictly living contents of the cell (cytoplasm and nucleus, chondriosomes and plastids) as distinct from the non-living (cell-wall, vacuoles, lipide granules, inclusions like starch, crystals, etc.). Chapter III stresses the correctness of Dujardin's classic description of the cytoplasm based upon a study, now over a hundred years old, of the living substance of the infusoria: like the latter, the plant's cytoplasm is a perfectly homogeneous substance, showing none of the structures variously described by later observers as reticular, fibrillar, aleveolar, granular or emulsion-like. The other physical and physiological properties of the cytoplasm are briefly discussed: its viscosity, torsional elasticity, density and irritability; its power of forming a peripheral layer (the ectoplasm) which is denser, more refractive and richer in lipides than the endoplasm but which, contrary to earlier belief, cannot be regarded as a morphological membrane nor differentiated by staining; lastly, its strange property of allowing passage to certain basic dyes, *e.g.*, neutral red and cresyl blue which, however, cannot stain the living cytoplasm nor the chondriosomes or plastids but accumulate only in the vacuoles.

Chapters IV and V are concerned with the constitution and physical chemistry of this complex colloidal system of protein and lipide molecules in a watery medium holding minerals in solution. Then follows the strictly morphological part of the book which relates largely to the special contribution of the Guilliermond school. Chapters VI to XIX describe the structure and rôle of the plastids and chondriosomes; the mysterious (and to some cytologists still improbable) relation between the chloroplasts and chondriosomes; the vacuolar system, the Golgi apparatus and other cytoplasmic formations; the lipide granules and, finally, the alterations produced in the cytoplasm by physical and biological agents such as X-rays, various salts, and parasites. The concluding ten pages give a full summary of the results. Of about 540 works cited in the Bibliography the vast majority have appeared since the year 1910. It was about this time that the discovery or perfection of certain techniques, the ultramicroscope, mitochondrial methods, vital staining, the micromanipulator and microcinema, enabled observers satisfactorily to stain the elusive chondriosomes and to examine them critically in the living state. Chondriosomes had already been demonstrated in plant cells by Meves as early as 1904, but the rapid development of the whole subject with the startling discoveries by Pensa (1910), Lewitsky (1911) and Guilliermond (1911), which suggested a close genetic relationship between the chloroplasts and chondriosomes, shows convincingly how in the history of science technique sometimes dominates discovery.

It is impossible, in this short space, to do justice to the mass of observations brought together in this valuable book; and most of them have no doubt been reviewed individually by others. But the highlights of the combined picture now presented are:—

(*i*) The cytoplasm is a homogeneous substance in the plant cell, as it is in the animal.

(*ii*) Except in the bacteria and blue-green algæ, it holds minute living bodies, the chondriosomes, sometimes called chondrioconts when they are rod-like, mitochondria when dot-like. Originally regarded as artefacts, the chondriosomes are now known to divide and change their form, showing a striking resemblance with bacteria in their size, shape and staining properties. This resemblance we now know to be purely deceptive; the chondriosomes are not symbiotic bacteria, as they were once believed to be. For one thing, they do not respond to the centrifuge as do bacteria within the same cell.

(*iii*) The origin of the chondriosomes is still a mystery. Possibly, as Lewitsky suggested, they arise by differentiation from the cytoplasm, but they have never been observed to arise *de novo*; they most probably pass on from cell to cell during division.

(*iv*) The plastids of green plants are only transformed chondriosomes. During the development of mature cells from meristems they have been found to arise by differentiation from some of the chondriosomes which become enlarged and are able to manufacture chlorophyll and starch. Conversely, the plastids have been observed, at certain stages in the life-history of green plants, to become smaller and smaller, to lose their chlorophyll, and finally to revert to the inactive form as chondriosomes. These transformations may be repeated in both directions several times in a life-history.

(*v*) "Nothing is positively known about the rôle of the chondriosomes". Like the plastids to which they give rise, they appear to be the seat of important surface phenomena in the metabolism of the cell, but the exact nature of these processes is shrouded in mystery.

(*vi*) The aleurone grains of seeds are only dehydrated and condensed vacuoles. On germination they take up water and swell up into vacuoles which contain a more or less concentrated colloidal solution capable of being shown up by vital stains, like the aleurone grains themselves.

(*vii*) The vacuoles probably arise *de novo*, through absorption of water by colloidal granules secreted by the cytoplasm.

(*viii*) The fungi possess chondriosomes but no trace whatever of plastids, even of the colourless type. Are they, in their origin, algæ dispossessed of their chlorophyll? What is the relation of the Cyanophyceæ, in which no trace is found either of chondriosomes or of plastids, with the rest of the algæ? Perhaps the non-green races of the Flagellata will help towards a solution of these questions. But the bacteria still stand quite apart, and baffle all attempts to line them up with the rest of the plant world. Are they plants at all?

(*ix*) What happens at death? You watch an apparently healthy cell, with only its vacuole stained in neutral red. Everything seems normal, but abruptly the stain leaves the vacuole, and colours the cytoplasm and nucleus. The change that has come about, expressed in this innocent way, must be a change of vast magnitude. What is the nature of this change? What is the mechanism of the vital processes that have now ceased? The narrowing down of this gap in our knowledge is the concerted aim of the morphologist, the cytophysiologist and the physical chemist.

B. SAHNI.

Food—the Deciding Factor. By Frank Wokes. (Penguin Special No. S. 87. Penguin Books Co., London), 1941. Pp. xi + 144.

During the last few months, the public is becoming increasingly alive to the necessity of a well-planned and equitable food policy for the world as a whole. Eminent scientists and economists of Britain are ventilating their views on this subject through the colums of *Nature*. It is believed that the adoption of a sane and humane food policy would be helpful in avoiding international conflicts which have become so dreadfully frequent.

In a Penguin Special the question of Food, which represents one of the most important deciding factors in the successful prosecution of a world war, is discussed by Frank Wokes in all its aspects. Morale on the Home front is as important as the offensive spirit on the battle-field and maintenance of both these essential qualities is intimately

bound up with the nutritional state of the two classes.

War-time food economy necessitates rationing and successful scientific rationing demands an intimate acquaintance not only with the principles of nutrition but also with the nutritional and vitaminic composition of the available foods. This fundamental knowledge and data are to be found in the book under review. In a series of seven lucid chapters, the author has dealt with the energy value of foods, the food values of starches, sugars and fats, the body-building values of foods, the value of mineral salts, the vitamin values of foods, losses of food value and the food value of dishes and diets. There is a descriptive Appendix of "Tables of food values". While the book is primarily intended to help the solution of the problem of food imposed on England by the war, the ideas developed in the book will prove helpful in the building up of a new world in which food will still remain the main deciding factor. This little book which is within the reach of every one, will receive the wide circulation it deserves.

V. S. G.

Reference Service and Bibliography. Vol. 1: *Theory*. By S. R. Ranganathan, M.A., L.T., F.L.A., and C. Sundaram, B.A., 1940, pp. 642. Vol. 2: *Bibliography of Reference Books and Bibliographies*. By S. R. Ranganathan, M.A., L.T., F.L.A., and K. M. Sivaraman, B.A., 1941, pp. 511. (Madras: Madras Library Association; London: Edward Goldston.) (n.p.).

These two volumes, it is hoped in the preface by the Madras Library Association, will help libraries in India and elsewhere to organize their work in an efficient, scientific and serviceable way. These are welcome additions to the library literature in the country. Skilfully have the authors traced the genesis and expounded the what, why and how of reference service in Parts 1-3; Part 4 encompasses the whole field of bibliographies including the subject of bibliography or "reference bibliography" as the authors prefer to call it. Vol. 2 is a bibliography to Vol. 1, so to speak.

It may be surprising for many to learn how helpful and informative can the library service be in various fields of knowledge if it is equipped with reference staff. With this background the authors have painted a splendid picture that is just what the titles of the two volumes indicate. The skill of bibliographical research, keen discernment of a librarian *savant*, analytical and interpretative ability of a scholar, and creativeness of a thinker, have all been deployed in penning the picture. Books, institutions, men, memories, incidents in day-to-day library routine, causes and effects, have been searched out, evaluated, and combined, with the result that the two volumes have a wide appeal to anyone who has had contact with a library or who is interested in problems of library service.

That the authors' exposition of the art of reference work is academic as well as practical is seen throughout the work and particularly in the assortment of problems which, with their worked out solutions, fill a number of pages of the pleasingly unorthodox Vol. 1. This book is also unique in the emphasis it places on indological allusions so that the truth of the subject-matter may be feelingly realized by the Indian reader. In this volume the authors put forth the thesis that reference books as a rule are "rather treacherous" and reference service is therefore not a *service de luxe* but a necessity—for guiding the unwary reader through the so-called ready reference works. In the *why* section, a vista of reference books has been opened before the reader, and each book has to bear the brunt of the authors' critical genius. This section is educative for educationists and librarians alike, although it cannot be said to be the last word so far as highly specialized and scientific matter is concerned.

The voluminous flow of pages of lucid, racy, persuasive style is remarkably free from transcription blemishes except on pages 213, 254 and 543 of Vol. 1 and on page 212 where the hog idiom has been pierced by a through. Perusal of foreign titles, however, leaves in general an uneasy feeling owing to their shortcomings of accentuation. Many readers would wish that the valuable references in footnotes were accompanied by names of publishers.

These minor points are not intended to detract from the general interest or message of the composite treatise. It assembles a vast amount of information which the ordinary user might find difficult to acquire,

This makes the work a reference work on reference works. It is adequately indexed, conveniently arranged for reference, and articles are decimally numbered. Throughout the work the reader is struck by the scholarship, personality and humanity of the authors.

The volumes will be profitably read by staff and users of libraries. They show librarians the way of making their service more efficient, give the more ambitious members of library staff an incentive to do reference service, and enable the reader to find his way about in libraries with a quiet confidence in the domain of reference books.

It is to be earnestly hoped that the treatise will contribute to bring about in this country the recognition—hardly nascent at present—that reference service in libraries really has the advantage claimed for it; and that quite independent of a thorough organization of library catalogues and other illuminating guides such as maps, charts, readers' handbooks, etc., modern reference service is a specific requirement if the five primordial laws of library service enunciated and expounded by the senior author in a monumental work published earlier in the same Series are to be satisfied.

G. T. KALE.

The Problem of the Pure Teak Plantation. By M. V. Laurie, M.A., I.F.S., and A. L. Griffith, M.A., M.SC., I.F.S. (Manager of Publications, Delhi), 1942. Price Rs. 3-10 or 5*sh.* 9*d.*

The technique of raising teak plantations has been thoroughly worked out by foresters in India and every year some 6,000 acres of artificial teak plantations are being added on to the forest estate of the country. At the same time, however, an uneasy feeling has prevailed amongst a section of the professional circles that all is perhaps not well with these plantations; that the promising early growth of these pure crops may later be attended with unexpected and grave consequences such as, for example, the deterioration of the soil—the ultimate capital of all forestry enterprise; that, in short, the dividend from the pure teak plantation may not be worth the depreciation in capital value. These misgivings found expression at the periodical Sylvicultural Conferences at Dehra Dun and the 1934 Conference opined that the time had come for revising the existing bulletin on the subject (Bulletin No. 78). Undertaking this revision, the present authors have compiled and interpreted the available data with commendable thoroughness, having cast their net very wide to garner the knowledge and experience of the Indian provinces, some of the Indian States and notably also of the Forest Research Institute, Buitenzerg, Dutch East Indies.

Every one of the charges against the pure teak plantations and the possible mistakes in their past management have been examined in detail. The suggested remedies are then considered. Finally, the authors conclude that "the case against pure teak as a general proposition has not been established and that from the purely economic point of view, the value of teak timber is so much greater than that of any other species likely to be grown with it, that relatively poor teak is almost always a sounder financial proposition than any other possible alternative". This, so far as it goes, is reassuring but the critics of the pure teak plantation can justifiably point out to chapter VI of the Record where the authors give a list of points on which the existing data, being either scanty or unreliable, do not warrant generalisations. This list includes such important subjects as soil deterioration, quality of the timber, heredity factors and the regeneration of the *second* rotation. These factors, it wll be noticed, are not amenable to the mere expression of subjective opinions (however competent and experienced the holders of such opinions may be) but demand prolonged experimental work and statistical interpretation.

This book with its eight plates of uniformly excellent photographs is a clear statement of our present state of knowledge and ignorance of the pure teak plantation in India. It forms an admirable introduction to all those who have to manage or would design further experiments on the teak plantation in its many aspects.

SCIENCE AND THE WORLD MIND

Science and the World Mind. By H. G. Wells. (The New Europe Publishing Co., Ltd., London), 1942. Pp. 63. Price 1*sh*.

MR. H. G. WELLS was born in 1866, which makes him 76 in 1942. He writes as vigorously to-day as he did forty years ago. In the pamphlet "Science and the World Mind", which was presented to a Conference organised by the British Association for the Advancement of Science meeting in London in September 1941, he repeats, and acknowledges that he repeats, certain statements about the world and mankind that he has made over and over again within recent years. Yet even the reader who is familiar with Wellsian ideas is not bored; on the contrary, the argument seems to gather force with each repetition. A man who is told by his doctor that he will be dead in six months unless he changes his manner of life may be truculent and incredulous, but will scarcely dismiss the warning with a yawn.

Mr. Wells' world picture is deeply coloured by biological concepts. The gist of the pamphlet is approximately as follows:—

Homo sapiens is a species belonging to the order of primates. So far, biologically speaking, the family Hominidæ included in that order has not been very successful; five of its six known genera or species are extinct and there may be several other species represented to-day only by scattered teeth and jaw-bones in Upper Pliocene or Lower Pleistocene deposits. "The record of the past", remarks Mr. Wells, "is on the whole against the idea of any survival whatever for the human strain. In the past, dominant orders, groups and species have generally vanished from the earth at the very crest of their domination. It is an old-fashioned ecological misconception that they have been competed out of existence. They have simply failed to adapt."

Man is failing to adapt. He cannot control the forces he himself has brought into being. He has abolished distance, he has made it possible for events to be known simultaneously throughout the world. With his knowledge and technical skill he can make the world produce abundance for all, or, alternatively, he can produce (and is producing) enough explosives to blast himself out of existence. In face of the possibilities of progress or destruction which confront him, he cannot rid himself of habits of mind appropriate enough in the days when the horse provided the most rapid means of locomotion and the spear was the most lethal weapon. If he does not adapt himself to changing conditions, and that quickly, he may "become one or a series of degenerating sub-human species, or end altogether".

What does the adaptation of *Homo sapiens* to the new environment which science has created involve? Mr. Wells enumerates a number of necessary adjustments: Federal control of the air and international transport; federal conservation of world resources; a Declaration of Human Rights which will ensure for every man participation in these resources. But all these, he says, are impossible without the creation of an enlarged and instructed "world mind". This in turn demands the dissemination of education and knowledge on a tremendous scale, and a universal language. Mr. Wells considers Basic English the most promising world language, but all existing languages are unsatisfactory. The words we use don't really mean what we think they mean—language as we know it is a blunt and inefficient instrument. As an example of a misleading and confusing word he somewhat unexpectedly instances the word "science" itself. Ask a dozen people what it means and you will get a dozen widely varying replies.

This formidable programme of adjustment is obviously out of tune with existing realities—an "impracticable dream". "But I tell you", says Mr. Wells, "that if you do not share in this dreaming, if you will not, in the dwindling time that remains to us, do your utmost to realise this dreaming, then, instead of your going out to make a dream come real, fresh nightmares will overtake you and yours and all you care for. . . . . Our children and our children's children will pay bitterly, in ignominy, in privation, in straitened unwholesome lives and general brutalisation, as Nature, without haste and without delay, after her manner, wipes them out".

The biological approach adopted by Mr. Wells is unquestionably open to criticism. Experience shows that we must be cautious in applying biological analogies to human affairs. The apostles of cut-throat

capitalism found justification in the works of Darwin. The chief inspiration of the Nazis is a false biological hypothesis—that of the superiority of a non-existent Nordic race. The fact that the Deinosaurs and Deinotheria failed to adapt and were extinguished does not really presage the imminent extinction of *Homo sapiens.* Man is an unusual animal, capable, unlike the Diplodoccus, of envisaging his own extinction. The new environment to which he has to adjust himself is created by his own inventive faculty and not by cosmic forces. *Rapid* advance to super-civilization or degradation to sub-human levels, in accordance with the hopes and fears of Mr. Wells' impatient mind, both seem improbable. But there is no doubt that this view of man as a precariously adapted and momentarily dominant species, not automatically destined for survival and dominance, is important and provocative. Seen against that background, many of our behaviour-patterns, patriotic attitudes and religious and mystical convictions become sheer nonsense.

In this pamphlet, as in many of his other writings, Mr. Wells appeals to scientists to take the lead in creating a "world mind" which will be ready to accept bold schemes of federation, economic adjustment and educational development. He has, perhaps, somewhat exaggerated views about the wisdom and influence of scientific workers. But a study of "Nature" and other scientific periodicals shows that some of the leaders of scientific thought are in fact thrashing out ideas for the creation of a more sensible world. Recently the editor of an English monthly rebuked "Nature" for its growing tendency to discuss such matters; it was becoming, he said, a *political* journal. Scientific workers should stick to their technical work. An obvious reply is that unless we succeed in ordering our affairs more successfully, scientific work may become impossible and its achievements cease to be of practical benefit to humanity.

Mr. Wells is a provocative and often an irritating writer, at once too hopeful and too pessimistic. We can agree with him that our species is passing through a period of danger and that the greatest and perhaps the only hope for ordered progress lies in "adaptation" of the type he describes. We can also agree that scientific workers can play a prominent part in creating an enlarged and more lucid "world mind". At the same time, we must realise that the creation of a better world, after the war has been won, will be a complicated and tremendous task, beset with disappointment. That is all the more reason why it should be faced with boldness and enthusiasm.

W. R. A.

THE GEOLOGICAL, MINING AND METALLURGICAL SOCIETY OF INDIA

THE Eighteenth Annual Meeting of the Society was held on Saturday, 22nd August 1942, in the Mathematics Hall, Central College, Bangalore. Pradhana-siromani Rajamantrapravina N. Madhava Rau, Esq., B.A., B.L., Dewan of Mysore, was the "Chief Guest". After Tea, Mr. S. Lakshmana Rao, Local Secretary (in the absence of Mr. N. N. Chatterjee, the Hon. Secretary of the Society), presented the Annual Report for the Session 1941-42. There was a marked increase in the membership of the Society during the year, there being 3 Honorary Fellows, 193 Ordinary Fellows, and 45 Associates at the close of the Session. Eleven Ordinary General Meetings were held at which a number of papers were read and discussed. With a view to encourage the study of Geology and allied subjects, the Society has decided to award this year three Silver Medals to the best papers on Geology, Mining, and Metallurgy, to be submitted by the Student-Associates of the Society from all over India. The proceedings of the several scientific meetings organised by the Society were, as usual, published in the *Quarterly Journal,* of which five parts were issued in the course of the year.

After the reading of the Report, Mr. B. Rama Rao (Director of Geology in Mysore), President of the Society, delivered his Presidential Address on "Mineral Deposits of Mysore". Mysore, he said, contains deposits of more than forty different types of useful minerals including the metalliferous ores, non-metallic minerals, rare earth minerals, and the gem stones. The principal metalliferous ores found in the State are those of gold, iron, manganese, chromium

and copper; while ores of lead, arsenic, and antimony are also found to a very small extent. Among the non-metallic minerals, there are more than thirty different types and many of them like quartz, felspar, china clay, limestone and graphite are now being largely mined and used in the ceramic, cement and other local industries which have been set up within the last ten or twelve years. On others like asbestos, bauxite, corundum, garnets, etc., investigations are being conducted as to how best to use them locally; and as a result of these, some more industries may be set up in the near future, which would require these minerals as their essential raw materials. Among the rare-earth minerals, small quantities of monazite, columbite, samarskite, and beryl are found in some of the pegmatites in the State, and they have not as yet been used for any purpose. Referring to the future development of the mineral resources of Mysore, Mr. Rama Rao concluded: "Till recently minerals were being mined solely for export, and without any forethought; the richest and the readily accessible portions of the deposits were being extracted leaving behind much of the material as unworkable, useless waste. This suicidal policy of mineral development needs a drastic change. To minimise such avoidable waste of the State's mineral wealth it is very necessary to open the deposits systematically, winning all but the absolutely worthless portions, and to classify the products obtained into several grades by careful sorting and blending, so that the different grades of the material may be supplied to the different industries, all of which may not need the best grades for their purposes. This can only be done by a centralised control, and the Geological Department in Mysore has, consequently, taken up the large-scale mining of some of the minerals which are needed for several of the local industrial concerns, so that it may distribute these minerals in the most economic and best means possible. The Department has also been conducting investigations as to the best means of utilising the portions of the mineral deposits left over, by improving their quality by concentration and by trying to use such grades in local industries. It needs a considerable amount of patient research to make the best use of the available mineral resources and by concerted efforts and continued cooperation of the several industrial concerns in the State, a very large portion of this mineral wealth can be utilised most satisfactorily and to the best advantage of the country."

After the Presidential Address was over, the Chief Guest, Pradhanasiromani Rajamantrapravina N. Madhava Rau, Esq., B.A., B.L., Dewan of Mysore, made a speech in the course of which he said that it was a real pleasure to him to have been able to participate in the function, and complimented Mr. B. Rama Rao, the President of the Society, on his most interesting survey of Mysore's mineral resources. He observed that the Mysore Geological Department was one of the earliest of its kind to be established in India, and that about 25 years ago the Government found it desirable to reorganise the Department with a view to expanding the scope of its activities to include not only geological surveys and theoretical research but practical work involving the exploration of the State's mineral resources for industrial purposes. This reorientation had beneficial results. The policy of allowing private enterprise to exploit the mineral deposits had not been very wholesome. This resulted in deposits of the best quality being removed indiscriminately for purposes of export and the mines being left with deposits of inferior quality which it was not economical to work. He instanced the cases of the manganese and chrome mines in the State. In his view it was best to be conservative regarding the exploitation of minerals.

Concluding the Dewan said that he was glad that the membership of the Society was open not only to geologists but also to persons interested in mining and metallurgy, for it was by the co-operative effort of all these that the mineral resources of the country could be utilised with the greatest advantage.

The President then declared the following members duly elected to the Council of the Society for the year 1942-43:—*President*: Mr. B. Rama Rao; *Vice-Presidents*: Mr. D. C. Nag and Prof. L. Rama Rao; *Joint-Secretaries*: Mr. N. N. Chatterjee and Prof. S. K. Bose; *Treasurer*: Mr. B. N. Maitra; *Librarian*: Mr. Santosh Kumar Ray; *Other Members of the Council*: Mr. K. V. Kelkar, Dr. C. Mahadevan, Mr. Chand Mall, Dr. Raj Nath, Dr. C. S. Pichamuthu, Prof. M. Chatterjee, Dr. A. K. Dey and Dr. Daya Swarup.

CENTENARIES

Ivory, James (1765-1842)

SIR JAMES IVORY, a Scottish mathematician, was born in Dundee in 1765. His father was a watchmaker. After matriculating at the St. Andrews University, he went to Edinburgh to study theology. But his mathematical bias made him come back to Dundee in 1786 as a teacher. In this capacity he introduced the study of algebra in the school course. Three years later he entered flax-spinning business and remained in it till 1804. Even in this interval he kept up his interest in mathematics and contributed four papers to the *Transactions* of the Royal Society at Edinburgh.

In 1804, he became a professor of mathematics in the Royal Military College. To facilitate his teaching work, he prepared a simpler edition of Euclid. His first paper to the Royal Society was read in 1809. It was on the classical theorem bearing his name on the *Attraction of ellipsoids*. His new method of determining a comet's orbit won for him the Copley medal (1814). The approbation of Laplace and the Royal Medals were won by his papers on *Refractions* (1826 and 1839). On the whole Ivory contributed fifteen papers to the *Philosophical transactions*.

Ivory was knighted in 1831 and was elected honorary member of several national societies. In 1829 he offered his scientific library to the Corporation of Dundee; though it was not then accepted for want of a suitable building, it was ultimately taken over in 1866 after the Public Library was established in the Albert Institute.

Ivory died unmarried at Hampstead, 21 September 1842.

Coues, Elliott (1842-1899)

ELLIOT COUES, an American ornithologist, was born in Portsmouth, New Haven, 9 September 1842. He had his education at Washington where his father was employed at the Patent office. Though he held office as assistant surgeon in the army his interest in birds which manifested itself in his boyhood was developed considerably by contact with the Smithsonian Institution. He wrote many elegant papers on the birds of North America and discovered many new species. The bibliography on ornithology which he appended to that fine collection of bird biographies entitled *Birds of the Colorado valley* exhaustively covers 1612 to 1877. He was one of the founders, and later a vice-president and president, of the American Ornithologists' Union. He collaborated in the edition of the *Check list of North American birds* (1886) and in the construction of the code of nomenclature by which it was governed. From 1884 to 1891 he contributed to the *Century dictionary* covering many aspects of biology and is said to have been responsible for upwards of 40,000 definitions.

While he was on an arduous journey through New Mexico and Arizona to collect data for a book of his, his health gave way and he died 25 December 1890.

University Library,
Madras.

S. R. RANGANATHAN.

SCIENCE NOTES AND NEWS

Pyrethrum in Mosquito Control.—Russel, Knipe and Ramachandra Rao record (*The Indian Medical Gazette*, 77, No. 8, August 1942) the successful use of water as a diluent for kerosene extracts of Pyrethrum for spray-killing mosquitoes. The "stock extract" was emulsified with water to two dilutions, *viz.*, 1 to 7 and 1 to 3; sodium lauryl sulphate ("Gardinol") was the emulsifier. The spray particles of the emulsion, under comparable conditions, are, naturally, heavier than of the pure kerosene extract, but in spite of this the emulsion spray is almost as effective as the pure extract of the flowers. The costs of the emulsion, as also the *per capita* expenses of field trials, are set out indicating a definite saving when water emulsions are used.

In this connection, it may be recalled that although pyrethrins have been proved to be lethal to mosquitoes and although the quality of any sample of pyrethrum flowers is assayed on its pyrethrin content, it is by no means certain that the insecticidal value of pyrethrum is solely traceable to its pyrethrins; thus Chopra and co-workers find that an aqueous extract of pyrethrum has insecticidal properties (*J. Malaria Inst. of India*, 1940, 3, No. 4) but it is well known that the pyrethrins are insoluble in water; the same workers record that the solid residue *after* the removal of pyrethrin I and II has both insecticidal and larvicidal properties. Further the practice of using pyrethrum residues, stalks, etc., in "joss sticks", "mosquito sticks", etc., is well known. Such sticks are *burnt* to produce the smoke and any pyrethrins present are probably completely destroyed during combustion. At the same time, it is established that smokes from burning pyrethrum and derris (rotenone also is almost completely destroyed by heat) are lethal to certain insects. A survey of the recent literature on these remarkable facts is made by Brightwell in an article on "Fumigation by smokes with special reference to Derris and Pyrethrum" (*Bulletin of the Imperial Institute*, 40, No. 1, March 1942). All this research is calling for a revision of the existing concepts on the active principles of the

well-known vegetative insecticides, their assay, preparation and mode of action.

Identification of Timbers.—With the increase of demand for wood, cheap timbers of poor quality are often put on the market under the name of better class timbers of established reputation. The Forest Research Institute, Dehra Dun, have recently published a pamphlet for the use of non-scientific men ("How to Identify Timbers, Pt. I—Hints on Identification of Indian Timbers", *Indian Forest Leaflet*, No. 21, 1942, price As. 4 or 6*d*.). This pamphlet deals with the characteristic and structural features of timbers in general which are of diagnostic value in a non-technical and lucid style. The text is illustrated with telling illustrations. The keys for the identification of timbers of commercial importance which are to be published in subsequent parts will be received with much interest.

B. G. L. S.

Sugarcane Wax.—Manufacture of sugarcane wax as a byproduct of the sugar industry has again attracted attention of the Governments of South Africa and the United States. R. T. Balch in America (*Industrial Reference Series, Part I, Chemicals and Allied Products* No. 76, October 1941—United States Department of Commerce) and about the same time Narasing Rao and Vidyarthi (*Indian Sugar,* 10, 23) report that the dried press mud-cake contains from 5 to 17 per cent. of wax. Since direct collection would not be economically possible, the American worker has used organic solvents for the extraction of the wax and for the separation of fat from the extracted wax. Toluene has been found to be a convenient solvent for the extraction of the wax from the pressed mud. The removal of the fat is done by cold diffusion using a selective solvent for which acetone is indicated. This method of fat removal has the advantage of the absence of the bad smell, which probably occurs in the putrefactive fermentation method.

On the basis of these results, the Sugar Plant Field Station, Houma, Louisiana, intend to set up a pilot plant.

It is interesting to note the observation of the Indian workers, that the cane-wax corresponds to flax wax and bees wax and contains sterols.

V. S. G.

A Simple Ultracentrifuge with Plastic Rotor.—K. G. Stern, School of Medicine, Yale University, has developed (*Science,* 1942, 95, 561) a simple ultracentrifuge with a rotor of a low density plastic material. This has resulted in a considerable simplification of centrifuge design and obviated the necessity of employing expensive steel and aluminium alloys which are now difficult to procure on account of the war. The first trials were made in Madison with 0·5-inch thick discs of polystyrene and of polyacrylic transparent resins of 1·5 and 2 inches respectively. These discs were transformed into simple air turbines. A two-inch Lucite turbine could be accelerated to 57,000 r.p.m. with the aid of 80 lb. air pressure per square inch as measured by the Kahler-Hunt photoelectric speed measuring circuit. After the mechanical features of the centrifuge had been improved in various respects, the construction of 6-inch plastic turbine was undertaken and the top speed thus far attained with this model, has been 17,400 r.p.m. at 48 lb. per square inch air pressure and an estimated free air flow of 40 to 60 cubic feet per minute, yielding a force of 20,200 times gravity at the centre of the analytical fluid cell which is situated at a distance of 6 cm. from the centre of rotation. This speed is sufficient to cover practically the entire size range of plant and animal viruses as given by Stanley, and in general, to bring about molecular sedimentation, at appreciable rate, of protein particles from about 10^6 molecular weight upwards. As examples of such materials, the sedimentation of earthworm hemoglobin and of Stanley's crystalline tobacco mosaic virus protein, with sedimentation contents of $S_{20} = 60 \times 10^{-13}$ and 175×10^{-13} and molecular weights of 3×10^6 and 40×10^6, respectively, has been photographically recorded, employing the 6-inch Lucite rotor.

The plastic rotors may be adopted to use in centrifuge microscopes as well as in analytical ultracentrifuges. Further developments and applications of this centrifuge will be followed with keen interest.

'Pectin' from Tamarind Seeds.—Pectin is an everyday article of food, and makes its appearance in jams, cold jellies, candies and confectionary. Most of it is prepared from the waste products of fruit juice industries such as apple pomace, lemon and orange pulp, etc. Pectin finds extensive application in other industries also. As a filler in soap it not only increases the yield but adds to its detergent properties. It is used in thickening rubber latex, as an emulsifier in cosmetics, and the metal salts find application as bactericides and as water repellents. The hitherto common sources of pectin are all easily perishable and the pectin industry had to be coupled on to the primary industries of fruit juice expression, etc. A recent examination of various seeds (*Indian Forest Leaflet,* No. 23, 1942, by T. R. Ghosh and S. Krishna) has led to the discovery of a rich source of pectin in the tamarind seeds available in India in considerable quantities as waste product. The seed kernals contain 60 per cent. pectin (alcohol precipitation) and a process for its isolation is detailed.

Photo-Electric Membrane Manometer.—The optical projection method of recording the pressure changes in the cardiovascular systems

of animals by using a membrane manometer, besides requiring a large space is not sensitive enough to record changes of low magnitudes such as auricular pressures in the turtle. The method herein (*Science*, 1942, 95, 513) described overcomes this difficulty by utilising the amplifying properties of electronic device and is found to be superior in every way. The light from a 75-watt exciter lamp of the type used in sound-on-film motion picture projectors is focussed on a small mirror attached on the diaphragm of the manometer and on reflection a small cone of it falls on a photoelectric cell. The arrangement is such that with zero pressure a small part of the light falls on the photo-cell, and as the pressure on the diaphragm is increased, the mirror is deflected and more light enters the photo-cell. The electrical changes brought about thus by the photo-cell are amplified by a push-pull direct coupled amplifier and the output can be utilized for deflection of cathode-ray oscillograph spot or for direct recording. The sensitivity can be easily varied by varying the gain of the amplifier.

The output of this device is linear over a wide range as determined by accurate calibration against a mercury column, connection to which is provided by a three-way valve joining the diaphragm chamber to a side arm or the needle as desired.

The device may be used to record 160 mm. Hg pressure change in the dog ventricle or 1 mm. Hg change in the turtle auricle. The frequency response is good and entirely depends upon the mechanical constants of the vibrating diaphragm. N. B. B.

Kraft Paper from Bamboo.—Kraft paper is now being manufactured in India on a large scale. Indian paper mills have undertaken this manufacture as a result of experiments at the Forest Research Institute, Dehra Dun, which established the suitability of bamboo as raw material for its production.

The average consumption of Kraft paper during the five years preceding the war was approximately 10,000 tons per annum. The use of kraft paper as wrapping and packing material has considerably increased in recent years.

Investigations were started at the Institute in 1937 to explore the possibilities of manufacturing kraft paper from indigenous raw materials. Bamboo, which is available in large quantities at a cheap price, was selected for the experiments and has proved suitable, according to an interim report published by the Institute.

Manufacture of Jute Shoes and Other Extended Uses of Jute.—According to the August issue of the Indian Central Jute Committee *Bulletin*, plaited jute is used for making soles of slippers known as "alpargatas". The manufacture of these slippers originated in Spain and later on it found its way into the Argentine Republic. The Civil War in Spain crippled the industry; and the manufacture of "alpargata" became a regular industry in the Argentine. This kind of footwear is very popular among the poorer classes of the Republic and its consumption is considerable. It is sold at a price which is equivalent to about Rs. 1-3-0 per pair.

In 1937, 254 establishments were exclusively or partially engaged in the industry in which about 7,000 workers and 300 officials were employed. In that year Argentine manufactured about 43,000,000 pairs of "alpargatas".

Two sample "alpargata" shoes have been received by the Indian Central Jute Committee from its Argentine Correspondent. The Director of the Technological Research Laboratories of the Committee is of opinion that similar shoes could presumably be made in India and a cheap article with jute canvas, or cheap cotton uppers might meet with a wide demand.

Burlap and jute supplies are so scarce in the U.S.A. that efforts to secure substitutes are being made in every direction. The jute industry in the country, it is stated, was during the past thirty years, "mortally" afraid of this very situation that had recently developed. The linoleum manufacturers in the U.S.A. are using cotton fabric instead of burlap as a backing. The cotton yarn spinners are reported to have made much progress in developing substitutes for burlap for baling skeins and warps. A Philadelphia firm is stated to have distributed samples of two substitutes made of twisted kraft paper—one of onion bag type of mesh and the other a closer bag weave. Burlap traders of the U.S.A. express great apprehension not only over these developments but with regard to the entire burlap and jute situation.

The *Bulletin* contains an almost exhaustive list of possible new and extended uses for jute.

The Quality of Cotton in Hyderabad.—The Director, Information Bureau, Hyderabad (Dn.), writes in a Press Note:—

"With a view to improving the quality of cotton in the Warangal Suba, H.E.H. the Nizam's Government have sanctioned a five-year scheme submitted by the Agricultural Department. The scheme envisages, *inter alia*, a thorough study of the local varieties, selection of desirable plants from cultivators' fields, production and trial of improved strains against local varieties and investigation into the possibilities of growing remunerative cotton crops in *chalka* soils.

The survey of the cotton crop in the Dominions has shown that the crop grown in the districts of the Warangal Suba is a mixture of several types and much of it is of the various inferior short-staple varieties. The result is that it neither meets the requirements of the Textile Mill in Warangal, nor does it bring an adequate price to the cultivator. The Warangal Mills, which cannot obtain their supplies of the required variety of cotton locally, have to import large quantities of it from other places, incurring considerable expenditure on railway freight. Realising the benefit that will accrue to it from the implementation of the proposed scheme, the management of the mill has offered to co-operate with Government in pushing on the work of cotton improvement in Warangal, by meeting the entire non-recurring expenditure of Rs. 11,000 on setting up a laboratory and half of the recurring expenditure amounting to Rs. 5,562 per annum.

The Cotton Research Laboratory is expected to be put up shortly, while work has already

been started at the Government Farm, Warangal.

Indian Central Cotton Committee.—At the monsoon meeting of the Indian Central Cotton Committee, held from 13th to 18th July 1942, with Mr. P. M. Kharegat, Vice-Chairman of the Imperial Council of Agricultural Research, presiding, the financial position of the Committee, with reference to schemes in progress and other lines of work which it may be necessary to undertake in future, received close attention. Much of the useful work done by the Committee is of permanent value. For instance, the introduction of Jarila cotton, which was largely financed by the Committee, had returned in two years nearly a crore and a half of rupees, *i.e.*, a sum almost equal to the total amount of cotton cess collected by the Committee since its inception. This was no mean achievement, and the Committee is entitled to be proud of it as being a definite indication of the way in which the funds of the Committee had been utilised to the best advantage of the cotton grower.

The present position regarding supply of hoops for baling cotton, fuel and other requirements of cotton ginning and pressing factories was discussed at length and necessary recommendations for immediate attention made to the Government of India.

The following schemes already in operation were extended for periods of about two years in each case:—Surat Seed Distribution Scheme, Scheme for Control of Selection 1 A in Surat Area, Scheme for Cotton Jassid Investigation in the Punjab, and Scheme for Improvement of Punjab-American 289 F/K. 25 cotton. The Scheme for breeding of wilt-resistant cottons in Surat Area was extended for a period of 5½ years. New schemes for studying the economics of clean picking on a large scale in the Bombay Presidency and for a crop-estimating survey on cotton in the Central Provinces and Berar were also sanctioned.

The pilot plant ordered from America for conducting experiments in connection with the production of chemical cotton, will be housed in a separate building in the compound of the New Bombay University Technological Laboratories.

It was agreed that the experiments for the manufacture of cellophane and similar materials should be undertaken at the Committee's Technological Laboratory. The Committee also approved of the recommendations that experiments should be undertaken on the study of the chemical finishes applied to chosen types of yarns and fabrics made from short-staple cotton. It was decided that the results of experiments on pre-cleaning and ginning of Indian cottons should be further continued.

Rao Bahadur Sir Madhaorao Deshpande, Mr. S. T. More and Mr. Madhava Reddi were elected as representatives of cotton-growers of the Committee on the Board of Directors of the East India Cotton Association for the ensuing cotton year.

Central Board of Irrigation.—At the annual meeting of the Research Committee of the Central Board of Irrigation, presided over by Rao Bahadur L. Venkatakrishna Ayyar, I.S.E., Chief Engineer, Madras, and President of the Board, just concluded at Simla, the reports of the five research stations in India, in addition to papers contributed on various subjects, were discussed.

In the Central Irrigation and Hydrodynamic Research Station, Poona, Report, mention is made of the new Approach Channel above the Sukkur Barrage, designed at this Station for the exclusion of sand from the right Bank Canals. This work was completed in early 1941 and the results obtained in the subsequent flood season have been very satisfactory. This Station also designed a siphon spillway for the Jamshedpur water supply reservoir. This Station also investigated the possibility of further supplies from rivers for irrigation purposes. The Nira and Godavari River waters were, however, found unsuitable for irrigation due to high salt content. Investigations were also continued on the reclamation of land damaged by high ground water level, and on the utilisation of town sewage as a manure for irrigated crops. At the Punjab Irrigation Research Institute, Lahore, it has been found that observation pipes in the ground do not show the true ground-water where the water level is high. At Malikpur the river model research station has been enlarged, and a number of successful model experiments have been carried out.

The Sind Research Station has carried out a number of successful model experiments in connection with canal regulators and distributary heads. These are of great importance on a large irrigation system, such as that of the Sukkur Barrage. It is essential to distribute silt in correct proportion between the various channels, and model experiments have been found to be an ideal method of designing distributary heads for this purpose. At the United Provinces Research Station, Lucknow, model experiments have been carried out in connection with percolation losses of water from channels and silting of reservoirs.

The papers presented for discussion at the annual meeting covered the subjects of:—(1) River Behaviour, Training and Control; (2) Sampling of Sand carried in Suspension and along the Bed by Rivers and Canals; (3) The Accuracy of Different Methods of Taking Discharges; (4) Soil Mechanics and (5) Rainfall Runoff. These studies have a considerable bearing on such important topics as fixing the river course, silting of reservoirs, compaction of earth in canal embankments and earthern dams, storage reservoirs, etc.

Regulation of Experiments on Living Animals.—Dr. P. Chalmers Mitchell, President, Universities Federation for Animal Welfare, London, writes in *Nature* (1942, **149**, 699), "At the end of June a somewhat rare event will take place. The Home Office will make an appointment under the Cruelty to Animals Act, 1876, which regulates the practice of experiments on living animals.

"An inspector under the Act exercises an important function, not, indeed, as a policeman, but in advising research workers as to the interpretation of their obligations in particular

cases. In view of the number of experiments licensed under the Act, direct supervision is not practicable on any material scale, but I assume that the majority of research workers do not desire to contravene the regulations, and that the inspector's guidance will in general be effective.

"The Act lays down a compromise between the claims of science, on the one hand, and the rights of animals, on the other; the line drawn in the practical application of the compromise must inevitably be an arbitrary one. Until somebody can lay down clear-cut rules which will command general assent, the best that can be done is to make as fair a compromise as possible. This calls for exceptional impartiality, and since a man with the indispensable scientific training will necessarily have a predisposition in favour of science, it is important that he shall also have an offsetting predisposition in favour of the other party in the compromise. This could be ensured by requiring candidates for the post to prove that they have in the past seen effectively associated with some effort to better man's treatment of animals, wild or domestic. Preferably they should also have veterinary knowledge."

Committee on Indigenous Systems of Medicine.—With a view to encourage the indigenous systems of medicine on a large scale and for improving the status of the Vaidyas and Hakims employed by the local bodies, etc., and to examine the allied matters noted below, the Government of Mysore are pleased to appoint a committee consisting of the following gentlemen with Rajasevaprasakta Mr. A. Subramania Iyer and Mr. T. K. Rama Sastry as the Chairman and the Secretary of the Committee, respectively:—Bishagratna Mr. M. Suryanarayana Pandit, Mr. N. S. Krishna Iyengar, Mr. K. C. Subbanna, The Principal of the Government Ayurvedic and Unani College, Mysore, Bishagratna Mr. B. V. Pandit, Mr. Hakim Md. Abdul Salam Aslam, Mr. Hakim Murtuza Khan, Shafikh-ul-mulk Khan Bahadur Mr. Mahomed Abbas Khan, Ayurvedopadhyaya Vaidyavallabha Mr. Singra Iyengar, Rajavaidya Pandit Mr. P. H. Chandrabhan Singh. The points which the Committee are to examine and report are:—

(1) Suggestions for improving the usefulness of the Ayurvedic and Unani College at Mysore.

(2) Formation of a Research Section for investigating the efficacy of herbs and drugs.

(3) Preparation and supply of standard Indian medicines to the various institutions by a central agency.

(4) Undertaking of legislation to regulate the qualifications of Vaidyas and Hakims and to provide for the registration of practitioners of the Indian system of medicine with a view to encourage the study and spread of such systems.

(5) Nature of encouragement to be given to hereditary Vaidyas and Hakims who have not passed the required examinations.

(6) The nature of control to be exercised over the work of Vaidyas and Hakims and the agency therefor.

(7) Grant of leave, pension, provident fund, etc., to Vaidyas and Hakims employed in public institutions or receiving grants-in-aid from Government or local bodies.

The Committee will hold its sittings in the Government Ayurvedic and Unani College, Mysore.

The Principal of the Ayurvedic and Unani College, Mysore, is requested to provide the necessary clerical and other assistance to the Committee.

The Committee is requested to meet early and forward its recommendations to Government before 10th October 1942.

The Deputy Commissioners of Districts, the Presidents of District Boards, the President, City Municipal Council, Mysore, and the Municipal Commissioner, Bangalore City, are requested to furnish promptly any information that may be required by the Committee in regard to the matters referred to it.

The Geological, Mining and Metallurgical Society of India, Calcutta.—The latest number of the *Quarterly Journal* of the above Society (Vol. XIV, No. 1) begins with a paper by Mr. N. N. Chatterjee on "Free Sulphur in Some Weathered Tertiary Coal Specimens of India", in which a brief descriptive account is given of 12 samples of coal which have undergone prolonged oxidation under laboratory atmospheric conditions. This description, together with the probable nature of the chemical reactions enumerated in the paper, will perhaps serve to explain the formation of free sulphur and sulphates in the specimens described. The next paper is a "Note on the Tertiary Sequence in Tripura State, Bengal" by Mr. E. T. Vachell of the Burmah Oil Co., Digboi, in which the correlations between the sub-divisions adopted by Mr. K. L. Das in his recent paper on the Tripura Rocks and the Standard Assam Succession as described by P. Evans are given. Then follow two papers, one by Mr. C. L. Malhotra on "The Working and Dressing of Marble in Makrana Marble Quarries, Jodhpur State", and the other by Mr. G. D. Banerjee on "The Effects of German Silver Addition to the Gray Cast Iron" which were recently awarded the "Student Associate Silver Medals", the former for the best paper on Mining, and the latter, for Metallurgy.

Technological Institute of North Western University, Chicago, was dedicated, according to *Science*, 1942, 95, 2473, in June this year. Built at a cost of $6,735,000 it looks like two letter E's laid back to back and joined by a central structure. There are six wings each of which is occupied by the six departments of physics, chemistry, civil, mechanical, and electrical and chemical engineering. The Institute was established through a gift from W. P. Murphy, inventor and manufacturer of railroad suplies, and was opened in 1939. When fully under way, it will have an enrolment of 900 men, all pursuing a five-year co-operative course which calls for alternating a three-month period of study in the class-room with an equal period of work in the industry. This plan is designed to train the student in practical as well as theoretical engineering and to

assist industry in training its future executives. More than $1,000,000 worth of equipment is already in use for teaching and research and adequate room for expansion has been allowed in all departments.

According to *Science*, 1942, 95, 2473, a National Registry of Rare Chemicals has been established by the Armour Research Foundation. Information on chemicals too rare to be listed in the catalogues of regular chemical supply houses will be filed with the Registry and indexed according to name, location and amount available. Chemicals to be found in the catalogues of supply houses are not included, but all those not available through regular channels will be listed. The file will be regarded as confidential and specific inquiries will be answered by the Registry. In transactions in which the owner of the chemical wishes to remain anonymous to prevent the disclosure of commercial secrets, the Registry will act as intermediary.

MAGNETIC NOTES

Magnetic conditions during August 1942 were more disturbed than in the previous month. There were 10 *quiet* days, 20 days of *slight* disturbance and one of *moderate* disturbance as against 1 quiet day, 21 days of slight disturbance and 9 of moderate disturbance during August 1941.

The quietest day during August 1942 was the 29th while the 16th was the day of largest disturbance.

The individual days were classified as shown below.

Quiet days	Disturbed days	
	Slight	Moderate
1–5, 8, 13, 14, 28, 29.	6, 7 9–12, 15, 17–27, 30–31.	16.

No magnetic storm was recorded during August 1942 while a moderate storm was recorded during the same month of last year.

The monthly mean character figure for August 1942 was 0·71 as against 1·26 for the same period of last year.

M. R. RANGASWAMI.

SEISMOLOGICAL NOTES

During the month of August 1942, 2 slight, 2 moderate and 2 great earthquake shocks were recorded by the Colaba seismographs as against 2 moderate and 6 slight ones recorded during the same month in 1941. Details for August 1942 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
		H.	M.	(Miles)			
1	Slight	18	04	8390	..	..	The earthquake shook the whole of the southern part of North Island, New Zealand. Hundreds of chimneys fell, thousands of windows were shattered in Willington.
1	Moderate	20	13	2880	..	..	
7	Great	05	14	6340	..	..	Epicentral region probably located in the neighbourhood of the Aleutian Islands.
20	Moderate	00	00	1540	..	..	
23	Slight	12	05	5130	..	..	According to Fordham University Seismographic station the shock is believed to have originated in the vicinity of the most westerly Aleutian Islands.
25	Great	04	21	10360	Epicentral region located near Lima, Peru, South America	..	One-third of Nazea, an important city in the southern Peruvian area which was rocked by the earthquake, has been completely destroyed. The first shock lasting almost 5 minutes was followed by several others over a period of 2 hours. Severa buildings were destroyed and damaged.

ANNOUNCEMENTS

At a meeting of the Federation of University Women in India, held on August 26, 1942, the President announced the granting of a Federation scholarship cf Rs. 180 for medical research to Miss J. R. Manjeri of the Cama Hospital, Bombay, and also the award of a Fellowship of the International Federation of University Women fcr £250 to Miss Bina Ghosh of Benares University and Oxfcrd. Miss Ghosh has gone to Harvard University for research work in Sanskrit. This is the second Indian graduate to gain an International Fellowship, the first being Miss Kamala Bhagvat of Bombay University.

The Federation of University Women in India is open to any woman graduate of a recognised University irrespective of race, caste and creed.

* * *

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 90, Nos. 4613, 4615 and 4616.

"Journal of Agricultural Research," Vol. 64, Nos. 9 and 10.

"Indian Journal of Agricultural Science," Vol. 12, Pt. 3.

"Journal of Chemical Physics," Vol. 10, Nos. 5 and 6.

"Chemical Products," Vol. 5, Nos. 7-8.

"Experiment Station Record," Vol. 86, Nos. 5 and 6.

"Indian Forester," Vol. 68, No. 9.

"Indian Farming," Vol. 3, No. 8.

"Quarterly Journal of the Geological, Mining and Metallurgical Society of India," Vol. 14, No. 2.

"The Indian Central Jute Committee Bulletin," Vol. 5, No. 5.

"Indian Information Series," Vol. 11, No. 100.

"Review of Applied Mycology," Vol. 21, Nos. 4 and 5.

"The Bulletin of the American Meteorological Society," Vol. 23, No. 3.

"Indian Medical Gazette," Vol. 77, No. 8.

"Nature," Vol. 149, Ncs. 3785, 3786, 3788, 3790 and 3791.

"Journal of the Bombay Natural History Society," Vol. 43, No. 2.

"Journal of Nutrition," Vol. 23, Ncs. 5 and 6.

"American Museum of Natural History," Vol. 50, No. 1.

"Indian Journal of Physics," Vol. 16, Pt. 2.

"Canadian Journal of Research," Vol. 20, No. 4-5.

"Science," Vol. 95, Nos. 2471, 2472, 2474-76.

"Science & Culture," Vol. 8, No. 3.

"Indian Trade Journal," Vol. 145, Nos. 1877-79; Vol. 146, Nos. 1880-89.

Books

Short Wave Wireless Communication Including Ultra-short Waves. By A. W. Ladner and C. R. Stoner. (Chapman & Hall, London), 1942. Pp. xiv + 573. Price 35*sh.*

On Growth and Form. By Sir D'Arcy Wentwcrth Thompson. (Cambridge University Press, London), 1942. Pp. 1116. Price 50sh.

Annual Review of Physiology, Vol. IV. Editors: James Murray Luck and Victor E. Hall. (American Physiological Society and Annual Reviews, Inc., California), 1942. Pp. 709. Price \$5·00.

Mathematics, Its Magic and Mastery. By Aaron Bakst. (Chapman & Hall, London), 1941. Pp. xiv + 790. Price 21*sh.*

Practical Physics for Intermediate Students. By V. Venkata Rao, D. A. A. S. Narayana Rao and T. S. Narasimhamurty. (Department of Physics, Maharajah's College, Vizianagram), 1942. Pp. 218. Price Rs. 2-4-0.

A Text-book of Intermediate Physics, Vol. II (in Tamil). By R. K. Visvanathan and V. N. Ramaswamy. (Annamalai University, Annamalainagar), 1941. Pp. 689-1372.

ERRATA

Vol. 11, No. 8, August 1942, page 334, Table I (*b*), under Moisture and Protein, the figures for Sode II and Golim should be as follows:—

	74·80	19·41
	75·30	19·60
and not	19·41	2·08
	19·6	2·86.

Vol. 11, No. 8, August 1942, page 330, Note entitled "Arc Lines of Copper in Flame Spectra"—

Add the following before the present opening sentence:—

In the course of an investigation which is in progress and a preliminary report about which has already been published on the study of the flame spectra of copper salts, we have found a few interesting points regarding the excitation of certain atomic lines of copper which it is our purpose to report in this note.

In line 9, *for* $3d^94s$ (3D) *read* $3d^9\,4s$ (^{3}D).

Add the following after the last sentence:—

Full details regarding these and other features of the flame spectra will be published elsewhere; I also feel it a pleasure to thank Prof. Dr. R. K. Asundi for valuable discussion.

975-42—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science", Bangalore.

CURRENT SCIENCE

Vol. XI] OCTOBER 1942 [No. 10

NON-FERROUS METALS

NON-FERROUS metals constitute a group of strategically important raw materials essential not only for the production of munitions but also for the peacetime development and maintenance of the engineering, chemical and transport industries which have become so characteristic a feature of modern civilisation. The discovery of mineral fuels—coal and petroleum—led to an extensive utilisation of metals in the fabrication of machines for the production and transmission of motive power. The rise of electrical energy as one of the principal and convenient sources of power has been responsible for the phenomenal demand for copper in recent years. While the iron industry may be said to have grown with the steam engine, the copper industry has developed with the electric motor.

The progress of chemical industries is closely connected with the development of the non-ferrous metals and its alloys. Copper has been extensively used in the construction of chemical plant, particularly those classes of equipment, evaporators and condensers, where heat transmission plays an important role. Lead has been responsible for the rise and expansion of the acid and allied heavy chemical industries.

A wide choice of alloy steels and monel metals is now available to the chemical engineer. These materials of construction have enabled him to fabricate chemical plant and equipment, remarkable for their resistance to chemical corrosion; they have facilitated the production of chemicals sensitive to metallic contamination.

Food and canning industries owe their rise and prosperity to tin, which is also needed for the making of solders, gun metals, bronzes and other alloys. Zinc is needed for galvanising steel and for alloying in the production of brasses. High speed machine tools depend upon tungsten, vanadium, molybdenum and chromium. Some of the fundamental catalytic reactions in industry are brought about by platinum, vanadium and nickel. An unfailing demand for antimony is maintained by the printing

trade and the metal is also used for the manufacture of shrapnel bullets. An increasing use of silver in industry is also perceptible. So far reference has been made only to the heavy non-ferrous metals and their alloys.

The recognition of aircraft as a means of quicker transport and as a powerful weapon of war, had led to spectacular advances in the metallurgy of light metals—aluminium and magnesium and their numerous alloys. The chief merit of these metals and their alloys, lies in their remarkable lightness coupled with tensile strength, which has been capitalised in the production of aircraft. The perfection of the numerous types of airplanes and the airships, opened a new and ever-widening markets for these light metals. In addition the manufacture of aluminium paint, aluminium foil and collapsible tubes has further extended the employment of this metal. In America an entirely new use for these light alloys was found in the manufacture of structural shapes for building and construction. Unless lighter meterials are substituted in construction, the increased height of skyscrapers would involve a proportionately higher cost for excavation and foundation work. In Germany, aluminium is replacing copper for the manufacture of electrical transmission cables. In the field of fermentation technology, high grade aluminium is perhaps the only metal so far discovered, which has been found suitable for the fabrication of fermentation tanks, trays and other equipment. The employment of other metals in place of aluminium has been found to prove more or less toxic to the process of fermentation. In the fermentative production of citric acid, aluminium of 99·9 per cent. purity, has got to be used in the making of the fermentation trays, since otherwise the process will not result in an economic yield of the product.

Addressing the members of the Electrical Engineering Society, Indian Institute of Science, Bangalore, Professor J. C. Ghosh, the Director of the Institute, told the audience that the position of non-ferrous metals in the country was unsatisfactory if not alarming. The loss of Malaya and Burma has created a serious situation with respect to the supplies of tin, zinc and lead. India needs five thousand tons of electrolytic copper, the entire quantity of which is imported. The Indian Copper Corporation at Ghatshila produces about six thousand tons of copper, most of which is utilised for the manufacture of household utensils and brass. A small but promising beginning has been made in the production of antimony. About 12 tons of crude antimony per month are now being produced at Vikroti near Bombay from the sulphide ores mined at Chitral.

The occurrence of nickel in India had not been suspected but more recently the metal has been reported to exist in the snow-bound Himalayan regions near Nepal. It is curious that nickel should always be associated with snow-bound tracts.

Professor Ghosh revealed that an extensive deposit of copper ores, has recently been discovered in the State of Jaipur. The country is capable of meeting its entire and ever-growing requirements of the light metals and alloys but at the moment the actual production of the aluminium has not yet commenced in spite of several earnest attempts. Experiments on the production of magnesium have been taken up by the

Indian Institute of Science at the request of the Hindustan Aircraft authorities. Although new and rich deposits of minerals may be discovered in the country, it would be difficult, for sometime to come, to obtain the necessary machinery and equipment for winning the metal from its ores. Under these circumstances, Professor Ghosh suggested the adoption of strict economy and systematic recovery of metals from scraps and wastes. He instanced the case of Germany and Japan where the recovery of tin from waste tin plate scrap constituted a flourishing industry. As a war emergency he pleaded for the development of refineries throughout the country with a view to recover the metals from wastes. In this connection, attention may be invited to an informative article on the disposal of scrap of important non-ferrous metals by Dr. Mitter which has just appeared in the October number of *Science and Culture.*

But the country needs a long-range plan with regard to these non-ferrous metals. The creation of the Utilisation Branch of the Geological Survey of India will be heartily welcomed. It is possible that the combined activities of these technical bodies will lead to the country's self-sufficiency with regard to these metals. The demand for these non-ferrous metals will become more and more pressing as the tempo of the country's industrial advance increases. The Aircraft and Shipbuilding Industries have been inaugurated in the country; there has been a spectacular rise in the development of chemical, electrical and engineering industries; the armament industry, initiated as an emergency step, will come to stay in a post-war India, as a measure of defence. All these industries would need more and more of non-ferrous metals and their alloys. In view of the industrial and strategic importance of these metals, the creation of a Central Institute of Metallurgical Research for non-ferrous metals would be more than justified; this is a matter which deserves the earnest attention of the Board of Scientific and Industrial Research and the Government of India.

BERYLLIUM COPPER ALLOYS

THE discovery of the alloying properties of beryllium is one of the outstanding achievements of metallurgical science and may be compared from the metallurgical, if not from the economic point of view, with the age-old observation of the effect of carbon on iron.

Beryllium transforms copper or nickel alloys with hardnesses comparable with that of steel. Previously it had not been possible to harden copper to any extent and certainly not to any degree which would permit a good cutting edge or a hard wearing surface to be obtained.

This advancement is achieved by the addition of only 2 per cent. of beryllium. Not only does beryllium confer hardness on copper or nickel but it increases their resistance to "fatigue", in fact, Be-Cu will stand up to reversing operations such as are met with in the operations of springs or flexible diaphragms for a longer time than any other known non-ferrous alloy.

The difficulty of extracting Be from beryl has been overcome for commercial purposes by reducing the metal into a matrix of Cu or Ni, giving a "master" alloy with comparatively low Be content at an economic price, which can be satisfactorily utilised for making up the finished alloys. Non-sparking hand tools, and non-magnetic Be-Cu alloys can be made soft or hard at will by a simple heat treatment,

HETERAKIS TRAGOPANIS, A NEW SPECIES OF THE GENUS HETERAKIS FROM THE INTESTINE OF A CRIMSON-HORNED PHEASANT

BY

M. B. LAL

(Department of Zoology, Lucknow University)

A LARGE number of these parasites were recovered[1] from the intestine of a crimson-horned pheasant, *Tragopan satyra* which died at the Prince of Wales Zoological Gardens in Lucknow.

Male.—Length about 8·0 mm.; maximum breadth 0·3 mm.; feeble lateral alæ present. Caudal alæ broad and well developed and tend to unite across the ventral surface, a little anterior to the pre-cloacal sucker. Pharynx and œsophagus including the bulb measure 1·05 mm. Œsophageal bulb is 0·25 mm. long and 0·2 mm. broad. Tail of the male is 0·51 mm. long. Pre-cloacal sucker lies at a distance of 0·16 mm. from cloacal aperture. The sucker is thickly chitinised around its margin. The chitin is specially thickened at the middle of the anterior and posterior border of the sucker and appears to project out like two teeth perpendicular to the margin of the sucker. The sucker measures 0·07 mm. × 0·04 mm. in cross axes. There are eleven paired caudal papillæ and one single median papilla. There are two pairs of long peduncled papillæ lying by the lateral sides of the pre-cloacal sucker besides a median short peduncled papilla which lies on the posterior border of the sucker. There are six pairs of papillæ around the cloacal aperture;

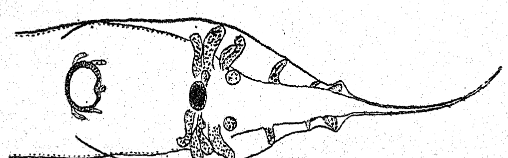

FIG. 1

Heterakis tragopanis (male), posterior end—ventral view showing arrangement of papillæ

four pairs of these have extremely long peduncles and extend into the alar projections. The remaining two pairs are small; the one by the side of the cloacal aperture has a short peduncle and the other situated a little posterior to it appears to be sessile and is rounded in shape. Posterior to these papillæ and post-cloacol in position lie three pairs of peduncled papillæ. These project into the alar membrane; the one proximal to the cloacal group of papillæ is larger than the two distal ones. The spicules are almost equal in size, the right one measures 1·6 mm. and the left which is slightly smaller than the right measures 1·5 mm.

Female.—Length about 10·00 mm. Maximum breadth in the region of vagina 0·4 mm. Pharynx and œsophagus including bulb

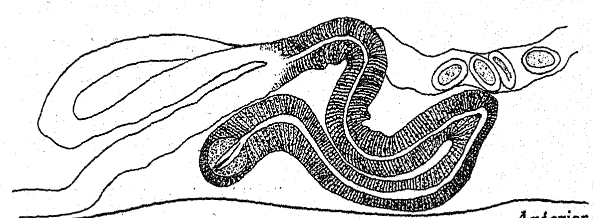

FIG. 2

Heterakis tragopanis (female), Vagina – latero-ventral view

measures 1·1 mm. of which the bulb occupies a length of 0·28 mm. Basal width of the bulb is 0·15 mm. The tail of the female is tapering into a long filament and measures 0·9 mm. The vulva which is protected by a pair of lips is situated in the pre-equatorial region of the body—4·8 mm. from the anterior end and 5·2 mm. from the posterior end. The vagina which is thickly muscular and capable of great expansion is 1·3 mm. long and runs cephalad from the vulva for half its length. It then bends caudad and after running for a short distance again bends cephalad but immediately

makes a sharp turn caudad where it divides into two uterine tubes. One of these after running caudad beyond the anal opening bends cephalad and runs anteriorly, the other shortly after divergence turns on itself and runs cephalad dorsal to the vagina. The eggs are oval and thick-shelled. They measure 0·075 mm. × 0·04 mm. in cross axes.

Discussion.—A large number of species[2] of the genus *Heterakis* have been described from different hosts in various parts of the world. The distinction between these species has been based apparently upon the number and arrangement of caudal papillæ, nature and size of spicules, size and position of pre-cloacal sucker, position of vulvar opening and size of eggs. Maplestone (1932)[3] is of opinion that none of these characters except the shape and, within wide limits, the size of spicules are constant enough to discriminate between the various species. He thinks that the other characters mentioned above are subject to very great variation and hence are not reliable for taxonomic purpose. He lays special emphasis on the shape of the tip of the shorter spicule. To me, however, this character appears to be extremely variable. Even Maplestone does not seem to be very clear on this point as in his own paper referred to here the following two statements need comment:—

On page 416, Maplestone says, "The only male characters which appear to be reliable for specific distinction are shape and within wide limits, the size of the spicules. This applies specially to the shorter spicule in all the species studied, for in practically every instance the tip has a characteristic barb or curve which only *varies slightly* within the species."

On page 405, Maplestone says, "Lane (1917)[4] in his description of the worm, under the name *H. vesicularis*, drew attention to the characteristic double curve at the end of the short spicule. This curve is only visible when the spicule is seen from the side, and I have found the degree and abruptness of the curve to *vary considerably* in different individuals."

The second objection in accepting Maplestone's view is the apparent difficulty in distinguishing between *H. gallinæ* and *H. variabilis*,[5] both of which are valid species according to Maplestone. In both cases the shorter spicule shows a more or less double curve at the tip and the size of the spicules in the two species also is more or less covered up uniformly by the measurements given. It may, therefore, be more desirable to consider all the characters together and not the character of spicule alone in distinguishing between the various species of the genus.

In view of these observations it may be said that the present form differs widely from most of the hitherto known species but comes nearest to *H. gallinæ*, *H. bosia* and *H. isolonche*. From all these species, however, it differs in the number, shape and arrangement of the caudal papillæ, relative sizes of the spicules, the size of the pre-cloacal sucker, and the course of vagina. It differs further from *H. gallinæ* and *H. bosia* in having a pre-equatorial vulvar opening and from *H. isolonche* in the position of the pre-cloacal sucker. It is, therefore, described as a new species.

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[1] I am thankful to Dr. G. S. Thapar who kindly offered me his collection of Nematodes for the purpose of the present study and made useful suggestions during the progress of this work. My grateful acknowledgements are also due to Prof. H. G. D. Mathur for the loan of some Journals from his library.

[2] See Cram E. B., "Bird parasites of the Nematode suborders Strongylata Ascaridata and Spirurata," *Bull. U.S. Nat. Mus.*, 1927 **140**.

[3] Maplestone, P. A., "The genera *Heterakis* and *Pseudaspidodera* in Indian hosts," *Ind. Journ. Med. Res.*, 1932 **20**.

[4] Lane C., "Suckered roundworms from India and Ceylon" *Ibid.*, 1914, **2**.

[5] Baylis, H. A., has since mentioned *H. variabilis* as a synonym of *H. isolonche*. (Vide *The Fauna of British India*, *Nematoda*, 1936, **1**.)

LETTERS TO THE EDITOR

THE EQUATIONS OF FIT IN GENERAL RELATIVITY

FOR an isolated mass of fluid having the boundary

$$f(x^\mu) = 0 \qquad (1)$$

the internal field is given by $g_{\mu\nu}$ satisfying the equations,

$$G_{\mu\nu} - \tfrac{1}{2} G g_{\mu\nu} = -KT_{\mu\nu} \equiv -k(p+\rho)\, v_\mu v_\nu + kp g_{\mu\nu}, \qquad (2)$$

and the external field by $g'_{\mu\nu}$ which are subject to

$$G_{\mu\nu} = 0. \qquad (3)$$

The equations of fit are usually stated as

$$g_{\mu\nu} = g'_{\mu\nu},\ p = 0. \qquad (4)$$

These boundary conditions are not usually sufficient. Consider, as an example, the external field,

$$ds^2 = -(1+m/2r)^4\,(dr^2 + r^2 d\theta^2 + r^2 \sin^2\theta d\phi^2) + \left(\frac{1-m/2r}{1+m/2r}\right)^2 dt^2 \qquad (5)$$

for $r \geqslant a$ and the internal field, for $r \leqslant a$,

$$ds^2 = -e^\mu\,(dr^2 + r^2 d\theta^2 + r^2 \sin^2\theta d\phi^2) + e^\nu dt^2. \qquad (6)$$

μ and ν are functions of r and when the differential equations for them are solved four arbitrary constants appear in them. The equations of fit (4) provide only three conditions. We find now that there is a fourth condition, *viz.*,

$$\left[e^{\mu/2}\, r^2 \frac{\partial}{\partial r}\,(e^{\nu/2})\right]_{r=a} = m, \qquad (7)$$

which has got to be satisfied if the distribution given by (6) is to behave like a particle of mass m at great distances. Using (4) and (7) we get

$$e^\mu = \frac{(1+m/2a)^6}{(1+mr^2/2a^3)^2},$$

$$e^\nu = \left(\frac{2-m/2a}{1+m/2a} - \frac{1}{1+mr^2/2a^3}\right)^2, \qquad (8)$$

$$8\pi\rho = \frac{6m/a^3}{(1+m/2a)^6},$$

$$8\pi p = \frac{(3m^2/a^4)\,(1-r^2/a^2)}{(1+m/2a)^6\,(1-m/a+mr^2/a^3-m^2r^2/4a^4)}. \qquad (9)$$

G. K. Patwardhan and P. C. Vaidya have shown in a paper, which is awaiting publication, how (7) arises from the principles of conservation. It is implicit in Tolman's[2] exposition

of these principles that the continuity of

$$-g^{\alpha 4}\sqrt{-g}\,\mathrm{A}^{\gamma}_{\mu\alpha} + \tfrac{1}{2}\, g^{4}_{\mu}\, g^{\alpha\beta}\, \sqrt{-g}\,\mathrm{A}^{\gamma}_{\alpha\beta} \quad \mu=1,2,3,4;\ \gamma=1,2,3 \tag{10}$$

"On the boundary is necessary. Here

$$\mathrm{A}^{\gamma}_{\alpha\beta} = -\Gamma^{\gamma}_{\alpha\beta} + \tfrac{1}{2}\, g^{\gamma}_{\alpha}\, \Gamma^{p}_{\beta p} + \tfrac{1}{2}\, g^{\gamma}_{\beta}\, \Gamma^{p}_{\alpha p} \tag{11}$$

This continuity ensures the conservation of energy and momentum provided

$$\frac{\partial}{\partial x^4} \iiint \Big(-g^{\alpha 4}\sqrt{-g}\,\mathrm{A}^{4}_{\mu\alpha} + \tfrac{1}{2}\, g^{4}_{\mu}\, g^{\alpha\beta}\sqrt{-g}\,\mathrm{A}^{4}_{\alpha\beta} \Big)\, dx^1\, dx^2\, dx^3 = 0, \tag{12}$$

the integral being taken over the whole space for $\mu = 1,\ 2,\ 3,\ 4$.

It is believed that the results (7), (8) and (9) are new. We are publishing elsewhere the full implications of Tolman's tacit assumption regarding the continuity of (12) which leads to (7). He seems to be unaware of (7).[3]

Lastly, another new point that has struck us in this connection may be noted. For the geodesies on the boundary surface we have

$$g_{\mu\nu}\frac{dx^{\mu}}{ds}\,\frac{dx^{\gamma}}{ds} = 1, 0, \tag{13}$$

$$f_{\mu}\,\frac{dx^{\mu}}{ds} = 0, \tag{14}$$

$$\Big(-\frac{\partial f}{\partial x^{\mu}}\,\Gamma^{\mu}_{\alpha\beta} + \frac{\partial^2 f}{\partial x^{\alpha}\partial x} \Big)\, \frac{dx^{\alpha}}{ds}\,\frac{dx^{\beta}}{ds} = 0 \tag{15}$$

along with (1). If there is to be no ambiguity about these geodesies (15) must be the same whether it is couched in terms of $g_{\mu\nu}$ or $g'_{\mu\nu}$. That this is true has been verified for spherical distributions.

V. V. NARLIKAR.
P. C. VAIDYA.

Benares Hindu University,
September 12, 1942.

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[1] Eddington, Sir A. S., *The Mathematical Theory of Relativity*, 1924, 93.

[2] Tolman, R. C., *Relativity, Thermodynamics and Cosmology*, 1934, 232.

[3] —, *Phys. Rev.*, 1939, **55**, 364.

ON A LACUNA IN THE TREATMENT OF INTERNAL SOLUTIONS IN GENERAL RELATIVITY

WE give here an example to show how the usual treatment of internal solutions is inadequate and sometimes even wrong. Consider a line-element,

$$ds^2 = -e^{\mu}\,(dr^2 + r^2\, d\theta^2 + r^2 \sin^2\theta\, d\phi^2) + e^{\nu} dt^2, \tag{1}$$

which satisfies the internal field equations for $r \leqslant a$ and is continuous with the isotropic line-element of the external field for a mass m. A new solution of the equations is given by

$$e^{\mu} = \Big(1+\frac{m}{2a}\Big)^4 \Big(\frac{r}{a}\Big)^{\lambda}, \tag{2}$$

$$e^{\nu/2} = \frac{1-\dfrac{m}{2a}}{1+\dfrac{m}{2a}}\;\frac{1}{2d}\,\Big(\frac{r}{a}\Big)^{1+\frac{\lambda}{2}-n} \Big[(c+d) - (c-d)\Big(\frac{r}{a}\Big)^{2n} \Big], \tag{3}$$

$$8\pi\rho = -\frac{a\lambda}{\Big(1+\dfrac{m}{2a}\Big)^4}\, r^{-\lambda-2}\Big(\lambda + \frac{1}{4}\lambda^2\Big), \tag{4}$$

$$8\pi p = \frac{a\lambda\,(c^2-d^2)}{\Big(1+\dfrac{m}{2a}\Big)^4}\, r^{-\lambda-2} \Big[\frac{a^{2n}\quad r^{2n}}{(c+d)\, a^{2n} - (c-d)\, r^{2n}} \Big], \tag{5}$$

where $c = 2+3\lambda+3\lambda^2/4$, $d = n\,(\lambda+2)$,

$$n = (1+2\lambda+\lambda^2/2)^{1/2}$$

For the pressure and density to be non-negative it is necessary that

$$0 \geqslant \lambda \geqslant -2+\sqrt{2} \tag{6}$$

when n is real. For imaginary values of n the solution can be similarly discussed. We take up now the question whether the distribution so obtained behaves like a particle of mass m at infinity. In the customary treatment this question is not examined and solutions like the one given above are understood as correct. Having discussed the equations of fit at $r = a$ we find that an additional condition, *viz.*,

$$\frac{m}{a} = -\frac{2\lambda}{\lambda+4} \tag{7}$$

has to be satisfied if the internal distribution is to have the same field at infinity as a particle of mass m. The equations of fit have been considered by two of us (V. V. N. and P. C. V.) in another communication to *Current Science*. The above solution is valid only if (7) is fulfilled.

P. C. VAIDYA.
V. V. NARLIKAR.
G. K. PATWARDHAN.

Benares Hindu University,
September 25, 1942.

SUNRISE MAXIMA IN THE INTENSITY OF DISTANT ATMOSPHERICS RECEIVED IN MEDIUM FREQUENCY CHANNELS

ANOMALIES in the intensity value of distant atmospherics during the sunrise and sunset periods were known for a long time. Eccles[1] observed a minimum during the sunset time and this was confirmed by other investigators. Potter's[2] work on atmospherics on a range from 5 Mc/s to 20 Mc/s indicated intensity maxima both during the sunrise and sunset periods. Double peaks were also observed by him during the sunrise period on some occasions. The recent investigations in this laboratory[3] on distant atmospherics, on a range from 2 Mc/s to 20 Mc/s, revealed intensity maxima in the early morning, some minutes before the ground sunrise and also in the late evening, some minutes after the ground sunset. Usually one maximum (and occasionally two maxima) was observed before the ground sunrise and one maximum after the ground sunset. An unmistakable maximum was also observed[4] on medium frequency during the sunset period.

The object of the present communication is to present the results of some experiments on 800 Kc/s carried out in early morning, well covering the ground sunrise period. The interpretation of the results and some conclusions therefrom are also given.

The peak method of measurement was employed in the work. A three valve receiver consisting of a H.F. amplifier, a detecting valve and a L.F. amplifier, was worked with a suitable frame aerial. The plane of the frame was directed towards the East-West direction and also towards North-South direction. The receiver was carefully calibrated and the fieldstrength of the atmospherics was estimated from the observed deflection in the balanced galvanometer placed in the anode circuit of the last valve in the receiver. Two typical sets of experimental results on 800 Kc/s are shown in Fig. 1. It should be observed that the intensity variation of the atmospherics about the sunrise time could be of either type A or B in the figure. Usually the fieldstrength was found to diminish rapidly and steadily as in type A long before the ground sunrise when the fieldstrength began to show an increase. In some observations, however, two distinct maxima were observed, as in type B, one after another, both before the ground sunrise. These maxima were followed by a rapid decrease in intensity, continuing for sometime even after the ground sunrise. If the observations are not made at very short intervals, there is liklihood that these maxima would be masked by the extremely rapid fall in the fieldstrength of the atmospherics. The A-type of intensity variation is therefore observed more frequently.

In a recent note by one of us,[5] the intensity maxima of the distant atmospherics observed

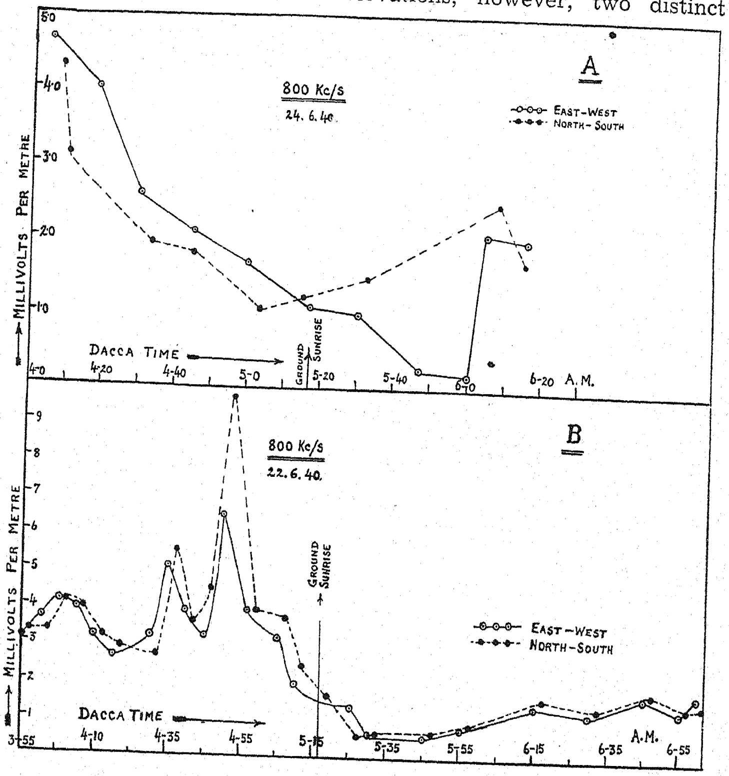

FIG. 1

before the ground sunrise and after the ground sunset have been explained. The early morning maximum has been associated with the ionization minimum in the E-layer observed in the small hours of the morning. Before the ionization minimum, it is evident, there is a gradual decrease in electron density in the layer. The collision frequency in the layer and hence the attenuation, diminishes gradually causing a gradual fall in the intensity of the downcoming waves, till there is a maximum when the E-layer ionization is minimum. After this minimum, the ionization *rapidly* increases during the sunrise period. This causes a large fall in the intensity of the downcoming waves owing to:—(1) higher attenuation due to larger collision frequency in the layer, and (2) larger deviation of the rays due to higher electron density. An early morning maximum is thus explained. The work of Mitra and his students[6] on the early morning increase of the E-layer ionization has, however, shown that the ionization begins to increase only when the solar rays strike the layer by grazing the top of the Ozonosphere which is at a height of 35 Km. from the earth's surface. In order to produce ionization in the layer, the solar rays must pass over the ozone region or else the shorter wavelength constituents of the sun's rays which cause ionization would be absorbed by the ozone.

If we denote the angular distance between the source of atmospherics and the receiving point (both being supposed on the surface of the earth in the East-West plane) by θ and the angle contained between the two tangents on either side of the Ozonosphere drawn from the point where the ionospheric reflection takes place be given by (180°-2ϕ), it can be shown that the instant when the solar rays would begin to produce ionization in the layer would be earlier or later than the ground sunrise at the receiving point according as $\phi >$ or $< \theta/_2$. It can also be shown that the difference between the instant of ground sunrise at the receiving point and the instant when the ionization begins to increase in the region, where the ionospheric reflection takes place, would be given by

$$t = 4(\phi \mp 2\theta) \text{ minutes.}$$

The upper difference sign is to be used, when the receiving point is to the east of the source of atmospherics and the lower positive sign when the receiving point is to the west. Thus when $\phi > \theta/_2$, the sunrise maximum is expected $(4\phi \mp 2\theta)$ minutes before the ground sunrise at the receiving point. When however $\phi < \theta/_2$, *i.e.*, when the source of atmospherics is *very* distant, the sunrise maximum should appear $(2\theta \mp 4\phi)$ minutes after the ground sunrise.

With the higher frequency components there would be penetration of the E-layer and reflection would take place from the F-layer. Following similar arguments we would expect another intensity maximum at $(4\phi' \mp 2\theta)$ minutes before or after the ground sunrise according as $\phi' >$ or $< \theta/_2$, where ϕ' for the F-layer corresponds to the angle ϕ in the case of the E-layer. The time interval between the two maxima associated with the E- and the F-layers respectively would then be given by $\Delta t = 4(\phi' - \phi)$ minutes. Taking the E-layer reflection height to be 80 Km. and the F-layer reflection height (for 800 Kc/s) to be 150 Km., we get $\phi = 6°\cdot 9$ and $\phi' = 10°\cdot 8$, so that $\Delta t = 16$ minutes. In the particular set of observations (type B) for the East-West direction shown in Fig. 1, the two maxima appeared 42 minutes and 27 minutes respectively before the ground sunrise. The time interval between the two observed maxima was therefore 15 minutes. The agreement is thus extremely satisfactory.

S. R. KHASTGIR.
R. G. BASAK.

Physics Laboratory,
Dacca University,
September 21, 1942.

[1] Eccles, *Handbook of Wireless Telegraphy and Telephony*, 1918, p. 176.

[2] Potter, *Proc. I.R.E.*, 1931, Oct. 19, 1731.

[3] Khastgir and Innas Ali, Communicated to *Ind. Jour. of Physics*.

[4] Khastgir and Rao, *Proc. I.R.E.*, 1940, Nov. 28, 511. Khastgir and Ray, *Science and Culture*, 1940, June 5, 772.

[5] Khastgir, Communicated to *Science and Culture*.

[6] Mitra, *Science and Culture*, 1938, March 3, 496. Ghosh, *Ind. Jour. of Physics*, 1940, April 14, part 2 101.

THE SYNTHESIS OF VITAMIN C BY RICE MOTH LARVÆ (*CORCYRA CAPHALONICA* STAINT)

The synthesis of vitamin C by certain lower forms of life, *e.g.*, *B. prodigiosus*,[1] marine algæ[2] and the orthopterous insect *Blatella germanica*[3] has been reported. In the present communication evidence is brought forward to show that rice moth larvæ can synthesise the vitamin.

The larvæ were grown (*a*) on whole wheat and (*b*) on a synthetic diet consisting of starch, wheat protein, ether extract of wheat, dried yeast and salt mixture. The larvæ were killed at various stages of growth, minced and extracted according to the method of Bessey and King[4] employing 8 per cent. trichloracetic acid. Vitamin C was estimated in the extract by the chemical method using the indophenol dye. The larvæ, though grown on diets practically devoid of vitamin C, were found to contain the vitamin in significant amounts, ranging from 0·07–0·12 mg. per g. of body weight (or 2·4–4·0 mg. per g. of dry weight). The validity of these results was confirmed by various chemical procedures which are summarised in the following table:—

Treatment of the trichloracetic acid extract of larvæ	% vitamin C remaining after treatment	Remarks
1. Nil	100	
2. Norit (Fox and Levy[5])	0	Reversible oxidation of vitamin C by Norit. Incomplete recovery probably due to partial adsorption of the vitamin by Norit.
3. Filtrate from (2) treated with H_2S. H_2S driven out by current of CO_2 ..	80	
4. Mercuric acetate (Emmerie and van Eckelen[6]) ..	100	Removal of interfering substances, *e.g.*, cystine and glutathione.
5. Oxidation at pH 5·3 by the specific enzyme from drumstic (Sreenivasan[7])		
a. Extract + enzyme (Incubated at 37°C. for 5 minutes)	0	Complete oxidation of vitamin C by the enzyme.
b. ,, (boiled)	100	
c. ,, + KCN 10^{-3}M	100	Inhibition of the enzyme by KCN.

These results indicate that the dye-reducing substance in the larvæ extract is vitamin C. On the inclusion of vitamin C in the synthetic diet the growth of the larvæ as well as their vitamin C content did not show any significant increase, indicating that the larvæ do not depend on an extraneous source of the vitamin for growth. This, together with the ease with which the larvæ can be grown on any solid diet, suggests a possibility of using them as experimental animals for the study of precursors of vitamin C. Experiments have been carried out in which various sugars were included in the basal diet at a 5 per cent. level, but so far no significant effect on the synthesis of vitamin C has been observed.

P. S. Sarma.
Kamala Bhagvat.
Nutrition Research Laboratories,
Indian Research Fund Association,
Coonoor,
October 3, 1942.

1. Buising and Peters, *Biochem. Ztchr.*, 1940, **304**, 134.
2. Norris, Simeon and Williams, *Jour. Nutr.*, 1937, **13**, 425.
3. Wollman, Giroud and Ratsimamanga, *C.R. Soc. Biol.*, 1937, **124**, 434.
4. Bessey and King, *Jour. Boil. Chem.*, 1933, **103**, 687.
5. Fox and Levy, *Biochem. Jour.*, 1936, **30**, 208.
6. Emmerie and van Eckelen, *Ibid.*, 1934, **28**, 1153.
7. Sreenivasan, *Ibid.*, 1936, **30**, 2077.

SYNTHESIS OF POSSIBLE LIPOPHILIC CHEMOTHERAPEUTICALS OF THE SULPHANILAMIDE GROUP

Although the compounds of the sulphanilamide group already evolved have provided medical science with one of the most potent weapons for the effective conquest of a number of intractable diseases of bacterial origin, there is still a long list of bacterial infections uninfluenced by the newer chemotherapeuticals; among the latter, leprosy and tuberculosis continue to constitute some of the major posers to chemotherapy. This justifies further exploratory work both on compounds closely related to

the effective substances already known and on their structural allies but with other substituents with the possibility of an extension of their range of therapeutic usefulness so as to include infections caused by the acid fast mycobacterium.

The place of long chain fatty acids, particularly those derived from the chaulmoogra and hydnocarpus oils, in the treatment of leprosy and tuberculosis has, at the present time, been established. Systematic study of the numerous acyl derivatives of the sulphonamides hitherto synthesised has disclosed a few members effective in combating experimental coccal infections in mice associated with a low order of toxicity[1]; some of them have also passed actual clinical trials[2] with some measure of success. However, with the sole exception of N^1-dodecanoyl sulphanilamide which is uncertainly reported on[3], none of the fatty acid derivatives of the sulphonamides appear to have been investigated as to their efficacy in tuberculosis or leprosy.

Increased oil and fat solubility associated with lipophilic properties may be expected to be conferred on the resulting compounds consequent to the introduction of fatty acid residues in the molecules of the sulphonamides. It is possible to conceive with some justification[3,4] of a deleterious action of such fatty acid derivatives on the "waxy" capsules of the ubiquitous tubercular and leprous bacilli resulting in a break down of their first line of defence and that the damaged or stripped bacilli may subsequently be rendered susceptible to the further action of the acyl derivatives themselves or the parent sulphonamides or whatever *active* products that may be developed *in vivo*. The present preliminary communication, wherein the nomenclature of Crossley, Northey and Hultquist[5] has been conveniently adopted, is an essay in this direction. Synthesis has, therefore, been effected of the 23 compounds, listed below, with their melting points. They do not seem to have been so far reported in literature.

(1) N^4-Cyclohexoyl sulphanilamide 238° C. (2) N^4-*n*, Caproyl, N^1-acetyl S.A.* 166°–69° d. C. (3) N^4-*n*, Caproyl, N^1-*n*, butyryl S.A. 164°–68° C. (4) N^4, N^1-Di (*n*, caproyl-) S.A. 164°–72° C. (5) N^4-*n*, Caproyl, N^1-*n*, heptoyl S.A. 148°–52° C. (6) N^4-*n*, Caproyl, N^1-cyclohexoyl S.A. 185°–87° C. (7) N^4-*n*, Caproyl, N^1-palmityl S.A. 123°–26° C. (8) N^4-*n*, Caproyl, N^1-stearyl S.A. 127°–30° C. (9) N^4, N^1-Di (*n*, butyryl-S.A. 217°–20° C. (10) N^4, N^1-Di (*n*, heptoyl-) S.A. 131°–34° C. (11) N^4-*n*, Butyryl sulphapyridine 206° C. (12) N^4-*n*, Caproyl sulphapyridine 197° C. (13) N^4-*n*, Heptoyl sulphapyridine 193° C. (14) N^4-*n*, Butyryl sulphathiazole 244°–46° d. C. (15) N^4-*n*, Caproyl sulphathiazole 198°–99° C. (16) N^4-*n*, Heptoyl sulphathiazole 202°–03° C. (17) N^4-Cyclohexoyl sulphathiazole 222°–23° d.C. (18) N^4–Palmityl sulphathiazole 140°–47° C. (19) N^4-Stearyl sulphathiazole 148°–50° C. (20) N^4-*n*, Butyryl sulphathiazoline 224–25° C. (21) N^4-*n*, Caproyl sulphathiazoline 181°–82° C. (22) N^4-*n*, Heptoyl sulphathiazoline 175°–76° C. (23) N^4-Cyclohexoyl sulphathiazoline 220° C.

S.A.* = Sulphonilamide.

The N^4-acyl sulphonamides (Nos. 1, 11-23) were prepared by condensation of the requisite acid chloride on the respective sulphonamides in the presence of pyridine. For the preparation of the N^4-N^1-disubstituted derivatives of sulphanilamide (Nos. 2, 3, 5-8), N^4-*n* caproyl sulphanamide—reported[6] to be as antistreptococcal as sulphanilamide itself but possessing much lower toxicity—constituted the starting material: the condensations with the desired acid chlorides were carried out in pyridine medium. The remaining N^4-N^1-disubstituted sulphanilamides (Nos. 4, 9, 10) resulted directly by the operation of slightly more than 2 mols. of the appropriate acid chloride on sulphanilamide itself in pyridine solution. The condensation products, obtained by dilution of the reaction mixture with excess of water, were severally purified through precipitation from their dilute NaOH solutions (decolourising carbon) by acidification. They were mostly recrystallised from alcohol when they separated out in colourless needles with the exception of Nos. 14 and 15, which were obtained as slightly pale plates or prismatic needles. The yields of the final products were, in all instances, good.

I am thankful to Col. S. S. Sokhey and Prof. R. C. Shah for their interest and to the

Lady Tata Memorial Trust for the award of a scholarship.

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Haffkine Institute,
Bombay,
October 2, 1942.

[1] Miller *et al.*, *J.A.C.S.*, 1939, **61**, 1198.
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Moore *et al.*, *Ibid.*, 1940, **62**, 2097.
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Robson and co-workers, *Nature*, 1942, **149**, 581; *B.M.J.*, 1942, June 6, 687.
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[2] Welebir and Barnes, *J.A.M.A.*, 1941 **117**, 2132.
Maxwell and Bazalis, *Ibid.*, 1941, **117**, 2238.
Parentiss and Kanealy, *J. Urol.*, 1942, **47**, 11.

[3] Crossley *et al.*, *loc. cit.*
Steinbach and Duca, *Proc. Soc. Exp. Biol. Med.*, 1940, **44**, 133.

[4] Bergmann and Haskelberg, *J.A.C.S.*, 1941, **63**, 2243.

[5] Crossley, Northey & Hultquist, *Ibid.*, 1938, **60**, 2217.

[6] Miller *et al.*, *loc. cit.*

CHLOROPHÆITE BEARING BASALTS FROM THE CUDDUPAH TRAPS (PRE-CAMBRIAN)

IN the course of a detailed examination of the basaltic lava flows associated with the rocks of the Cuddapah system (Pre-cambrian) in South India, the presence of chlorophæite has been noticed. Since all the occurrences of chlorophæite so far recorded in India are from the comparatively much younger basalts such as those of the Rajamahal series[1] (lower to middle Jurassic) and the Deccan traps[2] (early Tertiary), the present find of this mineral in rocks so old as the Pre-cambrian is of some interest.

Chlorophæite occurs in the top basaltic flows of both the Papugnee and the Cheyair divisions of the Cuddapah system. The Vempally basalt is composed of labradorite, augite and iron ores. Chlorophæite occurs as amœboid patches in the interstices, is bottle green in colour, and has a refractive index *higher* than canada balsam. It also occurs as pellets or spherules infilling cavities, and is then

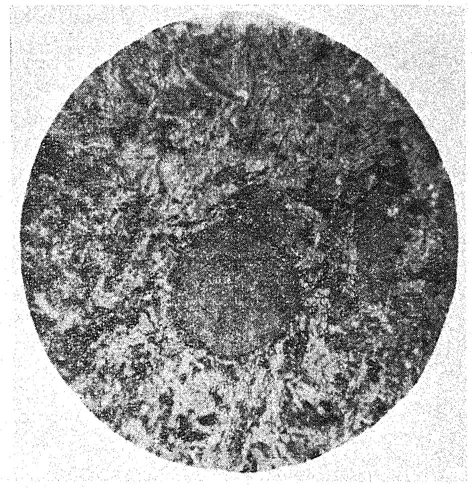

FIG. 1

Cuddupah Basalt, showing a large spherule of chlorophæite. Also shows irregular patches of chlorophæite in the groundmass.

bordered by spherulitic chalcedony. These spherules sometimes contain needles of epidote. The Banganapalli basalts show similar patches or spherules but the colour is yellow or brownish yellow, and has a refractive index *lower* than canada balsam. Chlorophæite is here accompanied by calcite.

The chlorophæite in these basalts has developed at the expense of the primary minerals as has already been observed in the case of the Deccan and the Rajamahal traps—felspar being the last mineral to be palagonitised, as microscopic fibres of chlorophæite are found surfeiting the felspars.

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Department of Geology,
Central College,
Bangalore,
October 7, 1942.

[1] Middlemiss, "On some Palagonite bearing Traps of the Rajamahal Hills and Deccan," *Rec. G.S.I.*, **22**.

[2] Fermor, "On Basaltic Lavas of Bhusaval," *Ibid.*, **58**.
Fermor and Fox, "Deccan Trap Flows of Linga," *Ibid.*, **47**.
Wadia, "Palagonite bearing Dolerite from Nagpur," *Ibid.*, **58**.

PREPARATION OF 3-BROMO-SALICYLIC ACID

THE direct halogenation, for example direct bromination of salicylic acid gives 5-bromo-salicylic acid along with 3-5-dibromo-salicylic acid and 2-4-6-tribromo-phenol. 3-Bromo-salicylic acid has been therefore obtained indirectly. Lellmann and Grothman[1] have prepared it from 5-nitro-salicylic acid but in poor yields. More recently, Hirwe and collaborators[2] have developed methods to obtain 3-bromo-salicylic acid from (*a*) 5-sulpho-salicylic acid and (*b*) chloralsalicylamide; in both cases, the yields are sufficiently good. However both the methods involve practical operations which are not easy to manipulate.

We have now to report a method for the preparation of 3-bromo-salicylic acid in good yields, which involves mercuration and is fairly simple. Salicylic acid is mercurated with mercuric nitrate at the temperature of boiling water. The mercury-derivative thus obtained is treated with bromine in glacial acetic acid when 3-bromo-salicylic acid is obtained in 60 per cent. yield. If the mercuration of salicylic acid is effected with mercuric acetate, instead of mercuric nitrate, the yield of the 3-bromo-salicylic acid is 50 per cent.

The compound is crystallised from alcohol in the form of needles; m.p. is 183°. The analysis for bromine are:—

Found Br 37·1 per cent.

Calculated for $C_7H_5O_3Br$, Br 36·86 per cent.

C. K. KANVINDE.
A. N. KOTHARE.
V. V. NADKARNY.

St. Xavier's College,
Bombay,

August 31, 1942.

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[1] Lellmann and Grothman, *Ber.*, 1884, **17**, 2725.
[2] Hirwe and collaborators, *Pro. Ind. Acad. Sci.*, 1937, **5**, 321–25.

ON THE OCCURRENCE OF SCLEREIDS IN THE LEAF OF *OLEA DIOICA*

THE occurrence of Sclereids or stone cells within the leaf-tissue has been recorded in many plants, particularly in some of the members of Oleaceæ and Ternstrœmiaceæ. The sclereid cells are scattered within the mesophyll tissue and according to Stevens (1924) they give hardness and toughness without being an impediment to increase in size. In the present note a short account of the morphology, and development of the scleroids, within the leaves of *Olea dioica* is given.

In mature leaves the sclereid cells traverse the mesophyll tissue (Fig. 1) connecting the upper and lower epidermis. They are flattened and anchor-shaped at either ends. In some cases the cells develop branches which anastomose and form a reticulum. Similar instances of elongated stone cells traversing the mesophyll tissue have been recorded by Vesque and Pirotta (Boddle and Fritsch, 1908) in *Olea americana, O. angustifolia, O. chrysophylla, O. europea, O. undulata* and in species of *Linociera* and *Noronhia.*

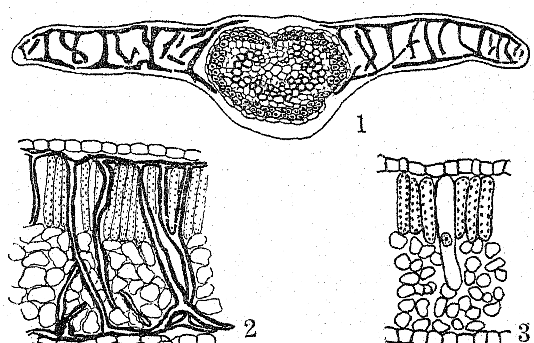

FIG. 1 Showing the sclereids within the leaf.
FIG. 2 Enlarged view showing the lumen within the sclereids.
FIG. 3 Palisade cell developing into the stone cell.

The developmental stages of the sclereid cells were traced in sections of the young leaves. The sclereid cell is the transformed palisade cell (Fig. 3). The palisade cell elongates in size becoming long and possessing a sinuous contour. The nucleus becomes slightly enlarged and migrates downwards. The cells are hayline owing to the absence of chloroplast. In the process of elongation the spongy cells are pushed aside. As development proceeds the elongated palisade cell forms short branches. The wall becomes thickened to a great extent and lignified leaving a

narrow lumen within the cell (Fig. 2). The nucleus degenerates and the degenerated mass persists even in late stages.

The sclerosed cells of the palisade tissue in *Linociera intermedia* Wight (Boodle & Fritsch, 1908) might also have a similar origin.

B. L. KRISHNASWAMY.

Bangalore,
September 9, 1942.

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WEIRS IN SOUTH INDIA AND THEIR EFFECT ON THE BIONOMICS OF THE HILSA IN THE SOUTH INDIAN RIVERS—THE GODAVARI, THE KISTNA AND THE CAUVERY*

PRIOR to the construction of these weirs, before the nineteenth century, one should presume that the spawning Hilsa had the whole run of the rivers excepting the upper reaches, and the eggs deposited in the freshwater sections found their way unobstructed downstream and the parent fishes also returned to the sea after spawning. The reduction of the spawning areas is, therefore, comparatively recent but none the less disastrous to the Hilsa fisheries in South India.

The distance between the first weir[1] and the sea in the rivers Godavari, Kistna and Cauvery, are respectively 60, 60 and 50 miles only. At present, it is in these short river-lengths that the parent fishes should spawn and the young larvæ reared. What with such a much diminished area for spawning and with the over-fishing caused by the fishermen taking advantage of the unsuspecting Hilsa in roe congregating below the first anicut, the survival of the Hilsa even in small numbers in South Indian rivers is a matter for legitimate surprise. What then is the remedy?

"Fish-passes" suggest themselves, but to be effective they presuppose two conditions:—

1. The fish whose protection is sought should have the habit of leaping in the air or swimming up-hill.

2. There should be the habit of spawning in the upper reaches only; when a fish can spawn in sections of the river in the plains, it cannot possess the urge to go uphill; the Hilsa do not seek the upper reaches and as a matter of fact they spawn even close to river-mouths. When the above two conditions do not exist, there is no case for fish-passes.[2]

The success of the Madras Government's efforts with Hatcheries has yet to be estimated. But the stocking of Hilsa-larvæ in short river-lengths does not forebode much success. The eggs generally want running flood-water for development and hatching and possibly the larvæ also need a period of sojourn in fresh-water. The short river-lengths which alone are now available for the spawners may not afford the time and distance necessary for the hatching and rearing of the larvæ before they could enter the estuaries and thrive there. If the larvæ enter the estuarine portion sooner than they should under natural conditions, a brackish-water environment may be lethal to them. The work of the hatcheries, therefore, may be a waste and no adequate return can be expected. Then again the uncertainty of procuring spawners during the spawning season is another handicap to hatcheries. Unless one is assured of a reasonable number of spawners, at a given place, in a given time, a hatchery cannot be worked with success. The experience of the Madras Fisheries Department has shown that the chances of obtaining spawners were very fitful and that the hatchery could not be worked annually.

Further, as South Indian Rivers contain little or no water for six months in a year, fish-passes constructed will then remain idle and money will have to be spent in watching them and keeping them in good condition. It occurs to me, therefore, that wise legislation such as prohibiting fishing within a five-mile (?) length of the river from the first weir, observing a closed season of a few weeks or restricting fishing below the first weir to three days

* Published with the kind permission of the Director of Industries and Commerce.

in a week may produce a salutary effect on the Hilsa-fisheries, as this will check over-fishing and give the spawners intervals to spawn unmolested by man and to add to the stock of the existing population of the Hilsa.

D. W. DEVANESEN.

Asst. Director of Fisheries (Biology),
Madras,
July 14, 1942.

[1] I have called the weir nearest to the estuary 'the first weir'.

[2] *Vide* page 355, "Dams and Fisheries: Mettur and Its Lessons for India" by Dr. B. Sundara Raj where the American Shad, a fish related to the Hilsa, is reported to have taken kindly to two Fish-passes with considerable width.

A NOTE ON THE USE OF POTASSIUM CHROMATE AS THE DELEADING AGENT IN THE DETEMINATION OF CLERGET'S SUCROSE IN SUGAR PRODUCTS

THE determination of sucrose by the double polarisation method involves leading a sugar solution and deleading the same with (*a*) sodium phosphate, (*b*) anhydrous potassium oxalate and (*c*) anhydrous sodium carbonate. We have re-investigated this method for sucrose by employing potassium chromate as a deleading agent, considering the possibility of an exact control of the added chromate with the help of silver nitrate as an external indicator. The absence of any such control in the case of the other deleading agents is well known.

By comparing the sugar added with the sugar recovered from waste molasses and distillery vinasses as recommended by E. Saillard, we found (1) that the sugar recovered from these two sources closely agreed with the sugar added only when the chromate acid and the chromate yeast methods were employed while with all other methods there was much divergence, (2) that the complications introduced by leading a sugar solution, namely, precipitation of glucose and fructose can be exactly balanced by deleading with potassium chromate, (3) that the effect of amides and aminc-acids was eliminated and (4) that the values obtained very closely agreed with the yeast inversion methods.

Methods of Analysis	Molasses			Distillery vinasses					
				Vinasses only			Further complicated by Amides and Aminoacids		
	Sugar Added	Sugar Recovered	Deviation	Sugar Added	Sugar Recovered	Deviation	Sugar Added	Sugar Recovered	Deviation
1. Jackson and Gills method	15·24	17·03	1·79	15·26	16·78	1·52	15·26	17·71	2·45
2. Chromate acid	15·24	15·11	−0·11	15·26	15·35	0·09	15·26	15·32	0·06
3. do. Yeast ..	15·24	15·11	−0·11	15·26	15·36	0·10	15·26	15·32	0·06
4. Carbonate acid	15·24	12·56	−2·68	15·26	14·06	−1·20	15·26	16·74	1·48
5. do. Yeast ..	15·24	13·58	−1·66	15·26	15·35	0·09	15·26	15·48	0·22
6. Oxalate acid	15·24	12·56	−2·68	15·26	13·59	−1·67	15·26	14·21	−1·05
7. Phosphate acid	15·24	17·04	1·80	15·26	18·07	3·81	15·26	16·92	1·66

The above are the typical results.

This shows that the chromate acid inversion method is a correct method, that the results agree with the yeast inversion method and this new method is a distinct advance over existing methods. Full details will be reported elsewhere.

S. VENKATA RAMANAYYA.
C. NARASINGA RAO.

Vuyyuru Sugar Factory,
Vuyyuru,
August 3, 1942.

THE FAT FROM THE SEEDS OF *VANGUERIA SPINOSA* (N.O. RUBIACEÆ)

THE seeds for the investigation were collected from a forest about 30 miles south-west of Kolhapur. The fruit (Mar.: *Alu;* Hindi: *Muduna, Moina*) is globose, smooth and yellowish brown when ripe, and is edible. The seeds are longish and biconvex.

The decorticated seeds were extracted with benzene, in a soxhlet, and the yield was calculated on this basis. The last traces of the solvent were removed by distillation under vacuum, whereupon the fatty oil set to a pale green solid mass.

The physical and chemical constants determined are given below. The details and the subsequent work done will be published elsewhere.

Yield of the fat 38·5 per cent.; Specific gravity at 24° C. 0·9515; Refractive index at 27° C. 1·4780; Acid number 3·98; Saponification value 191·0; Iodine value 88·72; Reichert-Meissel value 1·5; Polenske number 0·46; Acetyl value 5·66; Unsaponifiable matter 0·95 per cent; Melting point of the fat 50° C.

J. W. AIRAN.
S. V. SHAH.

Rajaram College,
Kolhapur,
September 28, 1942.

PRE-SOWING TREATMENT AND PHASIC DEVELOPMENT

HENCKEL AND KOLOTOVA[1] have suggested a method for inducing resistance to drought by repeatedly drying germinated seed. Although such a treatment increased the growth and yield of wheat plants no evidence was presented by these authors to show any acceleration in the developmental phases of wheat. In the course of work in this Institute on the drought resistance of Indian wheats it has been observed that wheat plants grown from pre-hardened seed reached anthesis earlier than those grown from untreated seed. As this observation has not been recorded so far as it has a vital bearing on the theory of phasic development a brief summary of relevant results is presented here. The details of the method used together with the full data will be published elsewhere. It will suffice here to state that the temperature and the duration of the treatment as well as the process of soaking were modified to suit Indian conditions. The treatment was also different in the case of the pot and the field experiments.

The results of the pot experiment (Table I) as well as of the field experiment (Table II) show an acceleration in the development of nine varieties of Indian wheat which though small is clear. The analysis of variance on the data shows that earliness produced by the pre-sowing treatment is very highly significant (at 1% point) for all the varieties. The highest response is of about six days in four varieties (mean of 24 values). Difference between earliest plants in some cases was, however, found to be more than 10 days. Three other varieties, *viz.*, I.P. 111, I.P. 114, Pb. 8-A did not give statistically significant results in both the experiments and therefore are not included in the tables of results. The growth and yield data which will be presented elsewhere clearly indicate that the pre-sowing treatment had a beneficial effect in all respects.

It would be well to point out here that the total time for which the seeds were kept in the swollen condition (germinated) was in all cases 24 hours. It is probable that by increasing the duration of the treatment a greater acceleration in development may be obtained. Experiments are under way to test this point.

In all the varieties the seeds had burst and the embryos were exposd. In some cases, *e.g.*, in I.P. 165, and Pb. 8-A the radicles had emerged. This fact in no way impaired the germinating capacity of the seed even though three successive desiccations after each soaking were given to the germinating seed. On the contrary the rate of germination, percentage germination, and the seedling growth rate were greatly accelerated in some of the varieties.

Another point worthy of note is that the germinated seed was stored for two months after the final desiccation before sowing.

TABLE I

Pot experiment

Wheat (Triticum vulgare)

Sown on 30-10-1941

Variety	Sowing to Anthesis (Days)		Earliness (C–P) (Days)	Treatment variance	
	Control (untreated) C*	Pre-hardening treatment P*		Error variance $n_1 = 1$, $n_2 = 46$	
			S. E.		
I. P. 4 ..	73·67	67·37	6·00 ± 1·37	15·30	S
I. P. 112 ..	72·08	69·33	2·75 ± 0·63	15·28	S
I. P. 120 ..	97·67	91·50	6·17 ± 0·67	68·21	S
I. P. 165 ..	73·17	69·25	3·92 ± 0·77	20·87	S
Pb. 9-D ..	105·50	103·29	2·21 ± 0·35	32·33	S
A. T. –38 ..	110·29	104·33	5·96 ± 0·43	145·90	S
C. P. H–47 ..	104·08	98·00	6·08 ± 0·80	46·00	S
Pb. C. 591 ..	100·56	97·58	2·98 ± 0·79	66·48	S

* = mean of 24 values

S = significant at 1% point

TABLE II

Field experiment

Wheat (Triticum vulgare)

Sown on 4-11-1941

Variety	Sowing to Anthesis (Days)		Earliness (C–P) (Days)	Treatment variance	
	Control (untreated) C*	Pre-hardening treatment P*		Error variance $n_1 = 1$, $n_2 = 58$	
			S. E.		
I. P. 52 ..	98·43	96·80	1·63 ± 0·50	10·64	S
I. P. 112 ..	100·06	97·23	2·83 ± 0·63	20·10	S
I. P. 120 ..	105·70	103·00	2·70 ± 0·59	20·60	S
I. P. 165 ..	93·40	89·67	3·73 ± 0·61	37·50	S
Pb. 9–D ..	106·10	102·03	4·07 ± 0·37	122·20	S
A. T.–38 ..	108·00	105·37	2·63 ± 0·54	24·20	S
C. P. H–47 .	107·67	103·17	4·50 ± 1·69	7·09	S
Pb. C. 591 ..	103·73	100·77	2·96 ± 0·45	41·07	S

* = mean of 30 values

S = significant at 1% point

In the light of the present findings it may be postulated that there is a separate developmental phase as influenced by desiccation (which may be termed the drought phase).

It also appears that the technique of vernalizing Indian crop plants will have to be considerably modified to obtain results of practical value by combining efforts to induce resistance to drought by pre-sowing treatment and to produce an early crop. Experiments have already been initiated in this Institute to throw more light on this question of agricultural importance.

In conclusion I wish to express my thanks to Rao Bahadur B. Viswa Nath, the Director, and Dr. B. P. Pal, the Imperial Economic Botanist, for providing facilities for work, and for valuable suggestions and criticisms.

J. J. CHINOY.

Botany Section,
Imperial Agricultural Research
Institute, New Delhi,
August 13, 1942.

[1] Imperial Bureau of Plant Genetics, *Bull.*, 1935, 17.

ALBINISM IN SUGARCANE

WHILE surveying the crops grown under sewage irrigation an interesting case of "Albinism" was observed in a local Pounda variety of sugarcane on the Municipal Sewage Farm, Nagpur. A similar case was also observed in Bezon Bagh, Nagpur, where the crop was irrigated with effluent and wet activated sludge. This occurrence was, however, not met with in any other cane field round about Nagpur.

The symptoms are white patches of varying dimensions along the midribs on the lower side of the leaf from the second to the ninth leaf. These patches are from 0·5 to 9·0 cm. in length and are not contiguous. In some cases the intermediate leaves were not affected, while in others all the leaves from the second to the ninth were affected. The patches are slightly raised above the normal surface of the leaf and are bound by a faint yellow margin. Corresponding to the albino areas on the lower surface of the midribs, slight discoloration on the upper surface was also observed which showed itself more prominently when the leaves were held against light. The percentage of affected plants was fairly high, ranging from 20 to 25 per cent.; but no difference in the general development and growth was noticed between the normal and the albino-leaved plants.

Microscopic examination of the affected portions of the leaf did not reveal any difference between the normal and albino parts except that the chlorophyll was observed to have been disorganised in the latter. It was also ascertained that the white patches were not due to any insect, fungal or bacterial infection.

Diseases of sugarcane showing chlorophyll deficiency as recorded by Subramaniam[1] are briefly described below:—

(1) *Sectional Chlorosis*: (Environmental factors—Double effect of cold weather and the presence of water within the leaf culm). Tops of the affected plants show sectional chlorosis.

(2) *Manganese Chlorosis*: (Manganese deficiency in soil solution). Parallel white lines are seen on the leaf-blade due to failing of chlorophyll to develop.

(3) *Dwarf Disease*: (Cause undetermined). Feeble chlorotic shoots commonly arising when infected setts are planted. (Reported only from Australia.)

(4) *Mosaic Disease*: Virus infection.

(5) *Streak Disease*: Virus infection.

From the previous description of the albino patches, it is quite evident that this occurrence is quite different from the diseases so far recorded. It was further interesting to note that these white patches on the midribs were observed only on the crop grown under sewage irrigation and secondly, that the patches were restricted to the lower leaves, new leaves coming after the onset of monsoon being free from them. The monsoon leaves had their normal even green colour. Albinism is generally said to be a hereditary character recessive in its nature. What this albinism is due to is being investigated.

Pantanelli[2] and Church[3] observed a variation in the composition of albino and normal leaves with respect to proteid and non-proteid nitrogen, and ash constituents respectively. Albino leaves show a significantly very high non-proteid nitrogen, potash and phosphoric acid and a low calcium content. Albino and normal green portions were, therefore, collected from the leaves and analysed. The results of analysis are given in the following table:—

Analysis of albino and normal parts

Constituents	Field No. 1		Field No. 2	
	Albino part	Normal part	Albino part	Normal part
Percentage in air-dry meterial				
Proteid nitrogen	1·10	1·09	1·12	1·09
Non-proteid nitrogen	0·18	0·21	0·18	0·19
Moisture ..	4·15	4·32	3·80	4·07
Ash	9·05	8·80	9·93	9·71
Percentage in ash				
SiO_2	42·00	39·10	53·70	45·40
P_2O_5	4·59	4·96	3·85	4·14
K_2O	20·60	22·90	21·30	23·60
CaO	7·70	8·96	6·02	6·86

Our results do not show any marked variation in the albino and green portions of the leaves, except rather low silica content and high P_2O_5, K_2O and CaO contents in the green portions.

K. G. Joshi.
D. B. Panditrao.
Agricultural Research Institute,
Nagpur,
September 15, 1942.

[1] Subramaniam, L. S., *Diseases of Sugarcane and Methods of their Control.*

[2] Pantanelli. "Über Albinismus" *in Pflanzenreich f. Pflanzenkrankheiten*, 1905, p. 1 (cited in *Manual of Plant Diseases*, by Paul Sorauer).

[3] Church, "Variegated leaves," *Gardner's Chronicle*, 1877. **2**, p. 586 (cited in *Manual of Plant Diseases*, by Paul Sorauer).

GROUNDNUT OIL FOR DIESEL ENGINES

Since the publication of *laboratory* results on the subject by J. S. Aggarwal[1] and others an opportunity was awaited to supplement the information by results obtained under actual working conditions. The difference in prices of crude oil and groundnut oil and the general apathy and fear for anything new delayed taking any trials so far.

To obtain continuous supply of crude oil in the mofussil is getting more difficult every day. Where the water supply, as of this place, depends for its power requirements ultimately on crude oil and alternative arrangements are not possible, the water service may have to be maintained irrespective of considerations of cost. It was thought proper, therefore, to try groundnut oil (available in plenty locally) as an experiment for future use and guidance.

The local Power House has two *'Deutz'* diesel engines rated 165 bhp. and coupled to a three phase AC generator each. Both the sets have to run together for most of the time the power house is working. Without disturbing the routine work, one of these engines was run on groundnut oil for ten days. It was also possible to run this engine for a short while on 103 kw., its normal load when the consumption came out to be 0·452 pounds per Kwh. Taking the efficiency of the generator as 90 per cent., it works out as 0·303 lbs./bhp.-hr.

The makers recommend light diesel oil (commonly known as "A" grade) for this engine and the test certificate of the engine gives 0·384 lbs./bph-hr. as the consumption of fuel. Presumably, the test is carried out with a fuel similar to "A" grade oil, and comparing these results it can be seen that the groundnut oil bids fair to be a substitute for "A" grade crude oil. However from the end of 1939 to this day, only "B" grade crude oil has been used and now a comparison with this oil shows the following in favour of groundnut oil:—

(1) Absence of black smoke from the exhaust.

(2) Less carbon deposit on the piston top or in the combustion chamber,

A slight deposit of organic matter was observed round the spray nozzle but it did not interfere with the working of the engine in any way. The consumption on an average load of 64 kw. did not materially differ in the case of the two fuels.

These observations are published in the hope that many others will try groundnut oil and pool their experience so that a war-time difficulty may be solved.

R. V. BARAVE.

Willingdon College,
Sangli,

P. V. AMRUTE.

Jubilee Electric Works,
Sangli,

September 7, 1942.

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1 "Indian vegetable oils as fuels for diesel engines," *Bulletins of Indian Industrial Research*, No. 19.

AN UNUSUAL INCIDENCE OF MORTALITY OF MARINE FAUNA*

AN unusual phenomenon of mortality of marine fauna occurred in the tide-pool on the southern (Ceylon) side of Krusadai Island on 17th May 1942. A list of the animals washed ashore along the shore of the tide-pool, which is about twelve furlongs in length from the Sandy Point to the Bushy Point of Krusadai Island is given below. A study of this list would show that a great damage has been done to the reef-fauna of the island. Casualty has been particularly heavy in the case of holothurians and fishes. The casualty of 756 specimens of *Holothuria atra* and 250 specimens of fish embracing 16 genera for a shore line of about twelve furlongs in one day seems to be a record.

Alcyonium pachyclados 5 colonies; *Peachia sp.* 36; *Gyrostoma sp.* 4; *Eurythœ complanata* 23; *Clibanarius longitarsis* 1; *Alpheus rapax* 68; *Palinurus sp.* 6; *Calappa philargia* 2; *Neptunus pelagicus* 21; *Goniosoma sp.* 3; *Atergatis sp.* 6; *Ocypoda spp.* 26; *Gonodactylus spp.* 17; *Squilla raphidea* 3; *Holothuria atra* 756; *H. paradalis* 9; *H. scabra* 23; *Salmacis bicolor* 5; *Pinna æquilatera* 3; *Haliotis varia* 2; *Cypræa arbica* 9; *C. moneta* 4; *Xancus pyrum* 1; one egg capsule of *Xancus pyrum* with 73 embryos in it; *Aplysia benedicti* 16; *Murœna spp.* 65; fry of *Chanos* 34; *Serranus leopardus* 1; *Therapon jarbua* 21; *Chætodon collaris* 2; *Heniochus macrolepidotus* 1; *Holocanthus imperator* 24; *Scatophagus argus* 7; *Pterois russellii* 2; *Teuthis marmorata* 4; *Holocentrum rubrum* 36; *Polynemus indicus* 6; *Antennarius hispidus* 1; *Mugil troschelii* 16; *M. waigiensis* 3; *Platyglossus sp.* 18; *and Tetradon sp.* 9.

The causes for this mortality are not definitely ascertainable. *Trichodesmium erythrœm*, Ehrenb, the small permanently planktonic alga, was swarming in the tide-pool on the southern side of Krusadai Island from the first week of May 1942; and from the 12th May the tide-pool became densely greenish yellow in colour with *Trichodesmium* and gave a very offensive smell. The gills and gullets of many of the fishes washed ashore were filled with packets of *Trichodesmium*. It therefore seems reasonable to conclude that the fishes were slowly asphyxiated by *Trichodesmium* obstruction before being washed ashore by the high tide that occurred in the night of 17th May 1942.†

But, as the mortality includes also sea-bottom fauna, such as crabs, holothurians, sea-urchins and mollusca, one should hesitate to attribute the disaster to *Trichodesmium* alone. It is suspected, as the sea was rough during those days, that there has been a violent current, churning the bottom of the sea, and involving the fish in the area.

The salinity of the sea water of this tide-pool ranged from 35·59 to 35·91 o/oo, and the surface temperature from 30·1 to 30·5° C. from 12-5-1942 to 18-5-1942.

P. I. CHACKO.

Krusadai Biological Station,
Gulf of Mannar,

June 23, 1942.

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* Published with the permission of the Director of Industries and Commerce, Madras.

† The Group Cyanophyceæ is known sometimes to cause the death of cattle in ponds by toxic secretions. Similarly the *Trichodesmium erythrœm* might have produced some kind of toxin causing the heavy mortality of the marine fauna.

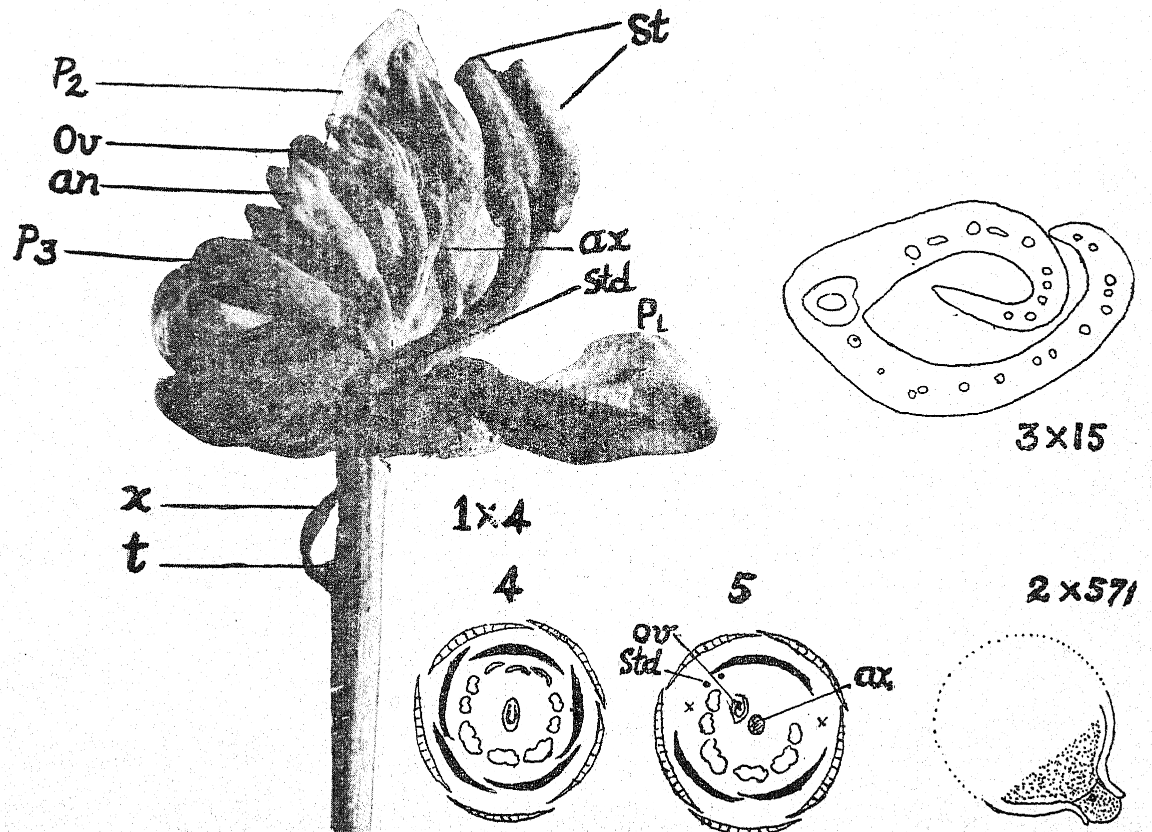
AN ABNORMAL FLOWER OF *CASSIA OCCIDENTALIS* LINN.

An abnormal flower of *Cassia occidentalis* Linn. has been examined (see Figs. 1-5).

(*a*) The unusually thick pedicel bears a short cylindrical appendage (x) in the axil of which is seen a small hump of tissue (t); the nature of these structures is unknown.

(*b*) There are only three petals, the two postero-lateral petals being absent. One of the three petals (p 3) is sepaloid, another (p 1) partly sepaloid.

In the abnormal flower there are six stamens (st) and a couple of small outgrowths, probably staminodes (std). In one of the stamens one anther (an) has become petaloid—a case of petalcidy already noticed in this species by Harris.[1] The anthers are of the normal type and contain normal pollen. A section of one of the undehisced anthers revealed a few pollen grains which had already started germinating with small tubes coming out of the germ pores (Fig. 2). The germination of pollen grains *in situ* is rather unusual but has



Figs. 1-5

1. Photograph of abnormal flower. 2. Pollen grain germinating *in situ*. 3. Transverse section of the incomplete ovary. 4 and 5. Floral diagrams of the normal and the abnormal flower respectively.

(*c*) In the androecium of the normal flower 3 to 5 of the theoretical number of 10 stamens are either reduced to staminodes or absent; the anthers are basifixed, with porous dehiscence.

been noticed in cleistogamous flowers by Madge[2] and West.[3]

(*d*) In the gynaeceum there is no well-defined carpel, but only a thick stumpy

structure (ov) which lies slightly displaced by the proliferating axis (ax); there is no evidence of any style or stigma, nor of any ovules or ovule-like bodies. The ovary-like organ, which is much shorter and thicker than the normal ovary, is not a closed chamber (Fig. 3) but in cross-section appears like an infolded leaf recalling a transition stage in the familiar derivation of a closed ovary from a leaf by the infolding of the margins. Both the inner and the outer surface of this 'ovary' are covered by hairs (not shown in Fig. 3). It is possible that this structure is a case of 'phyllody' of the carpel, of which several examples are given by Masters[4], Worsdell[5] and Kausik[6] though not in this species. My specimen differs from these in the absence of all trace of ovules or ovule-like bodies, and in the fact that the 'ovary' is not leaf-like in form but to all appearance looks like an ovary, only a section showing a resemblance to a transversely cut leaf blade.

(*e*) In the centre of the flower occurs a small shoot (ax) bearing a pair of young compound leaves with a growing stem tip between them—obviously a case of proliferation, many examples of which are cited by Masters (*l.c.*, p. 138) and by Worsdell (*l.c.*, pp. 16-17). The basal part of this axis is fused up with the stalk of the imperfect 'ovary' which has been displaced to one side by the axis. Masters (*l.c.*, pp. 139, 258) says that in proliferated flowers the pistils become 'disunited and leaf-like', a condition seen also in the flower here described.

The nature of the stumpy appendage (x) borne on the pedicel is difficult to determine. It may be a bract carried up on the peduncle, while its axillary hump (t) may be a foliar or flower bud, and this seems plausible in view of the proliferation of the vegetative axis through the flower. Another possibility is that it is a much reduced leaf bearing in its axil a gland similar to those that occur normally in the leaf axils of this species. Or the hump may be an undeveloped leaf bud, while the stump is stipular in nature.

The flower is interesting because it combines in itself a number of abnormalities, *e.g.*, petaloidy, suppression, phyllody, proliferation, etc., some of which have not been described in this plant.

My thanks are due to Mr. B. B. L. Srivastava, B.SC., who drew my attention to this flower.

A. R. RAO.

Department of Botany,
University of Lucknow,
September 5, 1942.

1 See Penzig, *Pflanzenteratologie*, 1921, **2**, 280; the original work by Harris has not been seen by me.
2 Madge, *Ann. Bot.*, 1929, 545–77.
3 West, *Ibid.*, 1930, **44**, 87–109.
4 Masters, *Vegetable Teratology*, 1869, 256.
5 Worsdell, *Principles of Plant Teratology*, 1916, **2**, 123–24, 193–95.
6 Kausik, *New Phytol.*, 1938, **37**, 396–408.

ON THE ALLEGED INHIBITORY INFLUENCE OF *TRICHODESMIUM*

ON page 243 of *Current Science*, Vol. 11, No. 6, dated June 1942,[1] John and Menon observe: "..... our observations in regard to certain points dealt with by Devanesan are at variance with his."[2] The alleged inhibitory influence of the alga *Trichodesmium* in the Travancore coast should be a regional one. The observations made in this Biological Station from 1924 lead one to infer that the inhibitory influence of *Trichodesmium* is due more to its occasional profusion[3] than to its unpalatable qualities. It seems to be a case of glut in the sea when on account of the sheer thickness of the floating *Trichodesmium* layer, the fish may react negatively to it. *Trichodesmium* has been recorded here as an occasional item of diet of the Mackerel, the Oil-sardine, the Sprat (*Sardinella gibbosa*) but frequently enough not to be regarded as accidental inclusions in the diet.

Another case in point is the Cystoflagellate *Noctiluca* whose swarms are alleged to cause

even local scarcity of the Oil-sardine shoals. Even *Noctiluca* is not free from being accidentally eaten by fish, for recently on 30-7-'42, a specimen of *Leiognathus splendens* examined here had *Noctiluca* in its stomach.

The explanation for the absence of fish-eggs in the stomach contents of the Oil-sardine and the Mackerel may be very simple after all, if one investigates the presence or absence of fish-eggs in the area. If the sea off Travancore is not a breeding-ground for fishes in general during the period when the shoals of these two fishes appear there, then it would be unreasonable to expect fish-eggs in their food. The sea opposite West Hill abounds in fish-eggs during certain months when the Oil-sardine and the Mackerel appear.

K. CHIDAMBARAM.

West Hill,
August 22, 1942.

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[1] John and Menon, *Current Science*, 1942, **11**, 243.
[2] Dr. Devanesan, *Ibid.*, 1942, **4**, 142.
[3] Gilchrist, *Marine Biological Reports* (Union of S. Africa), 1914, No. 2.

IT is not our intention to criticise or dispute the observations made by Dr. Devanesan. From Mr. Chidambaram's note it is evident that the inhibitory influence of *Trichodesmium* on fishes is a phenomenon which has been observed in the West Hill Biological Station also. Citing Gilchrist he says that this phenomenon is due more to its (*Trichodesmium*) occasional profusion than to its unpalatable qualities. In our previous note it was pointed out that large patches of *Trichodesmium* appear in the inshore waters of this coast at irregular intervals during December to April. When it occurs it does so in great numbers. During other months it is absent from the plankton. It is therefore natural that *Trichodesmium* occurs very rarely in the gut contents of the fishes of this coast. Mr. Chidambaram does not give any information regarding the seasonal distribution of the alga in the Calicut waters. A comparison of its seasonal variations in the two regions might explain the far too great frequency of this alga in the gut contents of the mackerels and other fishes of the Calicut coast.

Mr. Chidambaram observes that the absence of fish-eggs in the dietary of the Oil-sardine and mackerel can be explained "if one investigates the presence or absence of fish-eggs in the area". Our investigations have shown that fish-eggs are a common feature of the plankton of this coast during the mackerel and sardine seasons. So Mr. Chidambaram's hypothesis does not explain the absence of fish-eggs in the dietary of the Oil-sardines and mackerels of this coast.

C. C. JOHN.
M. A. S. MENON.

Marine Biological Laboratory,
Shankummughom, Trivandrum,
September 15, 1942.

STUDIES IN PHILOSOPHY

I THANK the reviewer for the generally appreciative tone of his review of my book "Studies in Philosophy", appearing in the July 1942 issue of *Current Science*. But it is my duty to offer a few words to correct certain misapprehensions that may be caused by some of his critical remarks.

1. Dr. Sarma objects to my characterisation of Dvaita as a species of Concrete Idealism.... ..... I would only say that in my considered opinion that phrase 'Concrete Idealism' is less misleading than Dr. Sarma's Radical Realism. Ontological idealism is quite consistent with epistemological realism. Idealism is protean in its forms. Parmenides, Plotinus, Kant and others belong to one type. But Hegel, Lotze, Pringle, Pattison, Sir Henry Jones and others belong to another. Dvaita resembles the latter in essential respects. Further, Dr. Sarma's critical note on terminology is rather misleading regarding the point and scope of my

chapter on the Notion of Difference. My treatment is devoted entirely to an exposition of the realist answer of Dvaita to the idealist denial of the existential status of difference by Advaita. I expect my readers to estimate the value of the Dvaita answer to the Advaita critique of difference. My characterising phrase of Dvaita as concrete idealism may be dropped without affecting the value of the discussion.

2. Dr. Sarma considers the analogy that I have drawn between Bradley's doctrine of "My Station and Its Duties" and the Gita account of "Swadharma" a case of doubtful parallelism. Perfect parallels are impossible, but vital resemblance is possible and is really exemplified here. There is nothing in the Gita to preclude the possibility of "Peons and Prime Ministers" with salaries from converting their daily humdrum occupation into a medium of self-realisation, provided they go about it in the spirit of self-dedication. There is no gulf between special religious ritual and secular vocation as media of attainment. ....

I must add that these comparative studies of mine have no motive other than the pursuit of truth. They may or may not contribute to the rapprochement of East and West. People with identical views may entertain feelings of mortal enmity with each other. ....

However, it is gratifying that my humble efforts should remind Dr. Sarma of Hegel's philosophic equanimity in time of war and of India's eternal quest in cultural endeavour.

M. A. VENKATA RAO.

Bangalore,
August 18, 1942.

.... I made it perfectly clear in my review that while Dvaita is *not* at all idealism, its description as "concrete idealism" must be a distortion. .... My stand has always been, whatever is connoted by Sankara's idealism, that is refuted by Madhva's realism. Thus, Sankara's being radical idealism or absolute idealism, Madhva's must be absolute or radical realism. Madhva's is all-round realism—ontological, psychological, epistemological, *et hoc.*

.... From Bradley to Sankara it is indeed a far, far cry. Having decried all activity, Sankara offers a constructive substitute in knowledge. Bradley does nothing like that. The gulf between the two in this respect is unbridgeable. The Gita ideal of Swadharma is strictly based on realisation of instrumentality in the hands of Divine Agency. Bradley makes no such theistic appeal. Viewed from whatever standpoint, parallelisms between Bradley and Sankara must be far-fetched and strained and doubtful.

Indian philosophy must stand on its own merits quite apart from the fact of its acceptance by the West. Thus comparative studies should always be based on real, and rational parallelisms. They have an end in view. That may be correct interpretation of Eastern thought to the West. I have always held that doubtful or superficial parallelisms defeat their own purpose.

R. NAGA RAJA SARMA.

Madras,
September 6, 1942.

[Owing to the necessity to economize space, we have had to omit some passages from both the letters. But no passage, material to the subject has been omitted.—ED., *C.S.*]

REVIEWS

Catalysis Inorganic and Organic. By Sophia Berkman, Jaque C. Morell and Gustav E. Gloff. (Reinhold Publishing Corporation, New York, U.S.A.), 1940. Pp. 1130. Price $18.00.

The subject of catalysis, both positive and negative, is of immense importance not only from the point of view of theoretical Chemistry but also from that of industrial Chemistry. The importance of this subject and the outstanding achievements of Ostwald, Sabatier, Haber, Bosch and Bergius in this field of study have been recognised by the award of Nobel Prizes in Chemistry to these world famous workers. If the phenomena of fermentation, photosynthesis in plants and biological oxidations in which catalytic reactions play an important rôle are included in this branch of knowledge, the names of Nobel Laureates like Buchner, Willstatter, Harden, von Euler, Meyerhoff, Warburg, St. Gyorgy, Hopkins and Neuberg appear in the forefront. Among the major industrial developments in Chemistry during the last fifty years, one may mention the contact method of manufacturing sulphuric acid, the synthesis of ammonia and its oxidation by air, the hydrogenation of oils and coal, the synthesis of numerous useful organic substances by catalytic dehydration, dehydrogenation, etc. The revolution in petroleum industry by catalytic polymerisation, catalytic hydrogenation, catalytic alkylation, catalytic isomerisation, catalytic cracking, catalytic reforming, etc., and the preparation of synthetic motor fuels by the catalytic hydrogenation of carbon monoxide, and of synthetic lubricants by polymerisation of olefines in presence of aluminium chloride constitute new advances of far-reaching importance. Many of the modern synthetic plastics and resins may be prepared by catalytic process from acetylene, ethylene or other substances obtained from petroleum and natural gas. The starting materials for the various synthetic rubbers are butadiene, isoprene, dimethyl butadiene, isobutene, chloroprene, styrene and acrylnitrile. The Buna rubbers prepared on a commercial scale in Germany are polymers or mixed polymers of butadiene catalytically synthesised from acetylene: acetylene-acetaldehyde-acetaldol $\rightarrow$ butene-glycol-butadiene-rubber polymers. The authors have brought out an important volume consisting of 1130 pages dealing with the different aspects of this phenomenon of catalysis. In the first few chapters the theoretical aspects of absorption, heterogeneous and homogeneous catalysis have been carefully discussed. Chapter 4 deals with the activity of the catalysts, Chapter 6 with promoters and poisons in catalysis, Chapter 7 carriers in heterogeneous catalysis, Chapter 8 catalytic reactions in organic and inorganic chemistry, and Chapter 9 physical conditions in catalytic reactions. Everywhere emphasis has been given to practical aspects of the subject. In Chapter 10 of nearly 350 pages, an attempt has been made to classify catalytic reactions in the different groups. This is a laudable and serious attempt at giving an orderly presentation of a subject which is growing extremely rapidly. The last chapter deals with catalysis in the petroleum industry, a subject in which the authors have to their credit important published researches. As promoters are of special interest and important chiefly in numerous catalytic gaseous reactions, great emphasis has been laid on this subject, the mechanism of which is far from clear.

The subject of negative catalysis is also of very great practical importance. Just as acceleration of a chemical change by catalysts has been utilised in numerous industrial operations, the retardation of a chemical change by a negative catalyst is also of great consequence. In the last European War, large quantities of sodium sulphite in a hydrated form were sent out from Europe to Mesopotamia for use as an antichlor to be utilised by the British troops for water purification. When this substance reached the destination it was wholly converted into sodium sulphate and was completely useless as an antichlor. Research work was initiated to discover a retarder for the oxidation of sodium sulphite by air and after a strenuous effort it was found that very small quantities of hydroquinone practically stopped the oxidation. Similarly by the addition of suitable negative catalysts, oils and fats, chloroform, ether, etc., can be preserved from oxidation and this use of

antioxidants has led to important industrial developments. Physiologists discovered that carbohydrates and fats, especially the former, can preserve the body proteins. This is also a part of the phenomenon of negative catalysis. Similarly carbonaceous substances preserve the soil nitrogenous compounds by acting as negative catalysts in the soil oxidation reactions.

Hence there is a great rush for the discovery of suitable positive and negative catalysts. The discovery that vanadium pentoxide can replace the costly element platinum in the manufacture of sulphuric acid has been a great boon to the sulphuric acid industry. The replacement of platinum in the oxidation of ammonia to nitric acid by air is a big problem for workers on catalytic reactions and if a cheap substitute is discovered it is likely to revolutionise the nitrogen industry. The authors have attempted to bring order in this subject which has developed at a tremendous speed during the last hundred years and they have been successful in presenting the subject systematically. This book will prove useful not only to academic chemists but will be largely utilised by industrial and manufacturing chemists.

N. R. DHAR.

An Introduction to the Chemitsry of Cellulose. By J. T. Marsh and F. C. Wood, with foreword by Sir Kenneth Lee. (Chapman & Hall, London), 2nd edition, 1942. Pp. xv + 512. Price 28*sh*.

This new book on the subject of cellulose chemistry has been written by two of the most successful scientific workers in the field of textile chemistry, who have to their credit the distinction of having achieved marked developments on the commercial side also. The subject has been dealt with not only to cover the latest researches in the subject from the point of view of the academician, but also to provide a guide book for the practising technologist, though for the latter, it would have been more useful if some information regarding the nature and types of plant commonly used had also been included. The authors however did not propose to include them as is evident from the title of the book.

The subject-matter has been divided into five distinct parts. In the first part, details have been given of the various types of impure celluloses obtaining in nature, their occurrence, quality, and methods of commercial purification. The general physical properties of cellulose, particularly those having a bearing on moisture absorption, and some optical, electrical, and mechanical properties have been fully discussed. In the second part dealing with the constitution and structure of cellulose, the authors have compiled complete evidence to establish the final chain structure of the cellulose molecule. The molecular weight data obtained by various investigators using diverse physical and chemical methods including some of the latest work involving the use of ultracentrifuge, X-rays, or viscosity studies have been taken into consideration. Allied studies regarding the structure of synthetic fibres such as Vinyon, and Nylon, and of regenerated fibres have been included, along with information regarding the chain structure of molecules in animal fibres such as silk and wool, to establish the final structure of the cellulose molecule by comparison. The important work of Meyer and Mark, and the data obtained in the X-ray examination and swelling studies of celluloses in their relation to establishing the molecular structure of cellulose, have all been fully dealt with. The subject of disperse cellulose dealing with Neale's Theory, mercerisation using various alkalis and organic bases, dispersion of cellulose using hygroscopic substances—inorganic acids and salts,—dispersion using specific reagents such as cuprammonium hydrate, carbon bisulphide and sodium hydroxide, and chloral, and finally the properties of the dispersed celluloses have been exhaustively considered in part three. The subject has been specially considered not only from the scientific point of view but also from the technological aspect, giving details of manufacturing conditions. Part four deals with the modified celluloses—hydro-cellulose and oxy-cellulose—and their properties. Some of the industrially important cellulose derivatives have been described in part five. The esters of inorganic acids, particularly the cellulose nitrate and its derivative rayon, the organic esters, with special reference to cellulose acetate, mixed esters, ethers, amino-celluloses and finally the most important soda cellulose and cellulose xanthate have all been described giving each the importance it deserves. The book has been nicely concluded with detailed description of the manufacture of viscose and some general considerations about cellulose and its rôle in our daily lives,

Close co-operation between the science and technology of textiles has had already a profound effect on the development of the textile industry and further advances can be ensured only by knitting a closer bond between the two. For persons engaged in industrial production and process control, who do not ordinarily have sufficient time to keep abreast with the theoretical developments in the subject, this book satisfies a real need, giving not only a connected account of the latest developments but also a complete bibliography. For the research worker just entering the field, the book is valuable in enabling him to pick out the important previous investigations without having to wade through the maze of patent specifications and diffused scientific literature.

The authors themselves being successful practising technologists working on the commercial side, details of technical processes given by them should be trustworthy and form a useful guide to the practical man. The book has been well planned and written in a readable style, although the very frequent introduction of references in the middle of sentences leads to rather discontinuous reading. But possibly the extensive literature cited by the authors could not be compiled at the end of chapters without causing other difficulties. It may have been better to insert them in the form of foot-notes in each page, with corresponding reference numbers only in the body of the text.

The X-ray and micro-photographs given in the book are about the best that have been so far published anywhere on the subject.

Although the first edition of the book was published only in 1938, extensive investigations on the subject during the last three years have made it necessary for the authors to bring out the new edition which they have done both justifiably and creditably.

A. N. RAO.

The Chemical Analysis of Ferrous Alloys and Foundry Materials. By E. C. Pigott. (Chapman & Hall, London), 1941. Pp. xv + 362. Price 28*sh.*

This is an excellent book on the technical chemical analysis of iron and steel and foundry materials. It covers 28 elements including the so-called rarer alloying elements like Beryllium, Boron, Cerium, Selenium, Tellurium, Columbium and Tantalum, which are now being used with sufficient frequency to merit inclusion of methods for their determination. Incidentally the introduction of more complex ferrous alloys had rendered some of the old standard methods of analysis obsolete and necessitated revision to meet the modern practice.

The book under review while meeting this need has some special features. The methods have been judiciously selected and brought up to date, several comparatively modern methods also finding their place. A discussion of the properties of each element and its relevant compounds and the theoretical considerations on which the principle methods of separation and determination are based precede the methods in the selection of which preference has been given to those methods which are of direct nature or of wider application. The methods of analysis which are given in sufficient detail are followed with explanatory notes giving the reactions involved in each step and the exact importance of various stages, thus giving the analyst a thorough grasp of the subject.

The chapter on definitions, many of which are very elementary, could have been usefully omitted. The generous use of equations, again many of which are too elementary, could have also been avoided. The publication is compact and almost free from errors.

MOHAMED ALI.

Intermediate Quantitative Analysis. By Welch. (University Tutorial Press, Oxford), 1941. Pp. 128. Price 3*sh.* 6*d.*

As usual this book describes the century-old (the so-called standard) exercises in volumetric and gravimetric analysis that form part of the curricula of studies for the undergraduate in all universities. It can at once be said that Section 2 is an apology for gravimetric analysis, despite the fact that gravimetric analysis lends itself to high order of accuracy. The author cannot be oblivious to this fact as is evident from his remarks in the introduction to the work and yet has caused a paucity of exercises in this branch.

The book opens with a description of the analyst's tools, such as the balance, burettes, pipettes, weighing bottles, etc., followed by exercises in acidimetry, alkalimetry, oxidation and reduction principles, iodimetry and precipitation methods. They are of a very representative character; additional exercises are appended to each chapter, which

are obviously intended for the student of leisure. The book is well illustrated with diagrams of apparatus which the students will be called upon to handle in the course of their practical work; the need to work with solutions of approximately equal strength is well brought out; the preparation and storing of standard solutions is neatly and lucidly described; the calculation of errors and their sources are briefly pointed out; the author remarks that the strengths of solutions must be consistently expressed in decimals of normal solutions, *e.g.*, 0·1035 N. The work abounds in samples of calculations from experimental data.

The author graduates his scale over which the pointer of the balance swings from 0 to 200 (Fig. 2, p. 5). There is no particular advantage to be gained by using such large figures but this may even lead to positive confusion, remembering the fact that in their high school and Intermediate career, students are used to smaller figures as 0 to 20 or 10 to the left and 10 to the right; internal, external and adsorption indicators have been very briefly described and their theory, so vital for a work of this kind, has been severely left out and the student is asked very politely to refer to advanced works in Physical Chemistry (p. 26); estimations of Calcium indirectly, and Lead, directly and indirectly, have been omitted. It augured a very happy future when sintered glass funnels were ushered into analytical work but one is disappointed to note that the author has not prescribed any exercise involving their use.

The book is carefully printed, neatly bound, is handy and can be safely placed in the hands of B.Sc. students of Indian universities.

K. Rami Reddy.

A Manual of Geometry. By N. K. Narasimha Murthy. (Prabhakar Book Depot, Fort, Bangalore), 1942. Pp. 120. Price Rs. 1-4.

This neatly got-up little book is the latest of its kind and is chiefly intended to meet the needs of the Intermediate of the Mysore University. The subject-matter has been arranged in logical order and the exposition is clear and simple throughout. The early introduction of 'Medial Section' closely following up the Problems on Areas is commendable. But, by changing the classical order of treatment in the chapter on 'Ratio and Proportion', the author has slightly marred the continuity of thought and has relegated to the background fundamental and elementary methods of demonstration for the sake of certain ingenious proofs, which can always be given as an alternative. It is also to be regretted that the attention of the student is not drawn properly and fully to 'the properties of harmonic ranges'. The propositions are followed up, wherever possible, by interesting foot-notes which adumbrate the use and importance of the theorems. Many model examples and important geometrical constructions have been worked out for the benefit of the student. The book contains a fairly good number of examples illustrative of the theory, though the miscellaneous collection is very meagre. On the whole, it can be said that this book is bound to be a valuable guide to the Intermediate students of the Mysore University for purposes of a written examination.

S. Krishnamurthy Rao.

Modern Inorganic Chemistry (in Tamil), Part II. By N. Ananthavaidyanathan. (Annamalai University, Annamalainagar), 1941. Pp. viii + 642. Price Rs. 2.

This is Part II of a pioneer attempt to write chemistry for the colleges in Tamil. The language is free, easy reading and accurate. An interesting feature of the book is the biographical and historical details as also the appropriate references in the form of extracts from Sanskrit and Tamil literature, to the chemical knowledge of our ancients. The chapter on qualitative analysis and metallurgy are particularly well written and shows the vast experience of the author in teaching the subject. Advanced matter not intended for the Intermediate classes is printed in small type. The many diagrams and photographs are clear-cut. Nearly 120 pages of this volume are devoted to equivalents of scientific nomenclature and terminology of chemicals, to an author index and to a subject-index. The get-up of the book is good. The author and the University are to be congratulated for this excellent work.

The reviewer feels that the intolerable situation with regard to the Tamil equivalents of chemical nomenclature and terminology might be ended if the equivalents given in this book be adopted as they have been formed with due regard to their usual and full significance.

While the page numbering of the second volume is started fresh, the numbering of figures continues from the first volume. It is rather inconsistent with the principle of retaining the universally accepted abbreviations in this vernacularisation that 'Centigrade' is represented by 'ச' and not by 'C'. While the author transliterates the word 'Lithium' it is unnecessary to show (p. 100) how the same might be called 'சோண சைலம்'. The reference to Thiruvannamalai on the same page, the paragraph on Mn dificiency diseases and their cure by rice husk (p. 404) the example of lead poisoning through use of 'ஸ்ரீ சூர்ணம்', the diagram on page 381 and similar things may be omitted from a text-book on Inorganic Chemistry.

The success of such enterprises as these could be judged only when universities follow their encouragement of such efforts by making use of these books.

Bharatiya Vaignanik (Indian Scientists). By Shyam Narain Kapur. Sahitya Niketan, Cawnpore), 1942. Pp. 364. Price Rs. 3.

An account is given in this book of the lives and works of the following twelve Indian scientists of international repute, namely, Dr. Mahendralal Sircar, Srinivas Ramanujan, Dr. Ganesha Prasad, Sir J. C. Bose, Sir Shah Sulaiman, Sir C. V. Raman, Sir P. C. Ray, Dr. Meghanath Saha, Dr. Birbal Sahani, Sir S. S. Bhatnagar, Dr. K. S. Krishnan and Dr. H. J. Bhabha.

This is perhaps the first book of its kind in Hindi and is sure to be of great value to readers of Hindi in understanding the achievements of persons whose biographies have been treated in the book. Without going too much into technicalities, the author has attempted to present to the ordinary reader the nature and substance of the researches carried out by each of the dozen scientists and the serious handicaps under which some of them had to labour on account of their country not being politically free. The author has taken great pains to collect information which is both accurate and interesting. The biographical sketches and the delineation of the personal traits and even the idiosyncrasies of some of these pioneers in science make interesting reading and remind one of the fact that scientists, though engaged in dry and abstruse pursuits in secluded laboratories, *are* as human as the poet or the novelist, a fact which is commonly ignored.

The book is illustrated and the printing and get-up are good though one would wish that for a book of this kind the types selected were bolder than the ones actually used.

M. V. JAMBUNATHAN.

OBITUARY

Dr. V. NARASIMHA MURTHY, B.Sc., M.B. & B.S., D.P.M., D.T.M., Dr.Ph.

WE deeply regret to record the demise of Dr. V. Narasimha Murthy at the prime of his scientific career. He was under forty.

Graduating from the Central College in 1924, he was one of the first to take his M.B. & B.S. degree of the Mysore University. As House Surgeon in the Victoria and Krishnarajendra Hospitals, he displayed an unusual keenness for research which received early and handsome recognition by the Government. He was entrusted with the investigation of typhoid and cholera in various parts of the State, which he carried out with praiseworthy enthusiasm, devotion and thoroughness. He took up the study of guineaworm disease prevalent in Chitaldroog; these studies won for him recognition as a research worker of great promise. He was deputed to the School of Tropical Medicine at Calcutta and spent some time at the Haffkine Institute at Bombay.

He was chosen as the Rockefeller Scholar and sailed for America in 1936. On his return to India in 1938, he had fewer opportunities for pursuing his scientific research. He fell a victim to the disease which he was investigating and the best medical aid that was rendered to him could not save a precious life so full of promise in the field of scientific research.

Dr. Narasimha Murthy was an endearing and loyal friend and as a scientific investigator, he was highly esteemed by his colleagues.

We wish to offer our sincere condolences to his bereaved family.

CENTENARIES

Manning, Robert (1784-1842)

ROBERT MANNING, an American pomologist, was born at Salem, Mass., July 18, 1784. His business was first that of a broker and later that of a stage-coach manager. In 1817, he began in a small way to collect choice varieties of fruits. In 1823 he established a pomological garden. Getting into touch with many noted fruitmen of Europe, he imported many scions and trees of choice varieties, in spite of the risks due to the slowness of pocket boats in those far-off days. At the time of his death he is said to have possessed the finest collection of fruits in America and one of the best in the world, consisting of over 1,000 varieties of pears alone and nearly as many more of the other fruits combined. His *Book of fruits* (1833) is a valuable catalogue of many "varieties of pear, apple, peach, plum and cherry" and is responsible for having established correct nomenclature of fruits and means of identification.

Manning died October 10, 1842.

Wigner, George William (1842-1884)

GEORGE WILLIAM WIGNER, the founder of the Society of Public Analysts, was born at Lynn October 19, 1842. Though he showed a liking for chemistry, he had to find employment in a bank for the first five years. After hearing him give a scientific lecture, Mr. Frank Hills employed him in his chemical works, where he remained for four years taking out several patents for sewage treatment. By 1872 he began independent business. During the next twelve years he published twenty-five papers and two books: the *A.B.C. of sewage process* and the *Seaside water*. Wigner took an active part in promoting the Sale of Food and Drugs Act of 1875. In the same year he founded the Society of Public Analysts and was the editor of the *Analyst* from its inception till his death. In 1880 he was rewarded by the National Board of Trade of the U.S.A. for drafting a Food and Drug Bill for them. In 1884 he acted as a juror in the International Health Exhibition at London and analysed some hundreds of food samples exhibited.

Wigner died of stricture of the œsophagus October 17, 1884.

Howell, Thomas Jefferson (1842-1912)

THOMAS JEFFERSON HOWELL, an American botanist, was born at Pisgah, Montana, October 9, 1842. He went to school only for six months; but he acquired a little knowledge of English and Latin by his own efforts. He was a farmer; but he soon developed an interest in studying the flora of his district and built a herbarium, which contained about fifty new species. *Picea brewariana* is said to be one of the discoveries of Howell and it is claimed that it should have been named *Picea howellii*. By 1887 he was in a position to publish *A catalogue of the known plants of Oregon, Washington and Idaho* which was the first book of the kind for that region. He next thought of publishing a flora for the same region. But as he was too poor to pay the printer, he learnt the compositor's art and though he was too illiterate even to syllabify words, he composed and printed his *Flora of North America* between 1897 and 1903. This is said to be still the only flora for the three States it covers.

Howell died at Portland December 3, 1912.

S. R. RANGANATHAN.
University Library,
Madras.

SCIENCE NOTES AND NEWS

Vitamin Content of Honeys.—Honeys obtained from various regions of Minnesota, from other localities of the U.S.A. and a few samples of foreign honeys, when tested by microchemical and microbiological methods for the presence of various vitamins, were found to contain thiamine, riboflavin, ascorbic acid, pyridoxine, pantothenic acid and nicotinic acid (*J. Nutrition*, 1942, 23, 280). The different samples showed a considerable variation in their vitamin content, which is given below. It is suggested that these variations may be partially due to the variable amounts of pollen present in honey.

Thiamine 2·1-9·1 μg./100 g. Riboflavin 35-145 μg./100 g. Pyridoxine 227-480 μg./100 g. Pantothenic acid 25-192 μg./100 g. Nicotinic acid 4-94 mg./100 g. Ascorbic acid 0·6-6·5 mg./100 g.

The samples of honey tested appear to be rich in pyridoxine, pantothenic acid and nicotinic acid.

Clarification with diatomaceous earth, although it increases the attractiveness of honey, tends to reduce its vitamin content; hence it is recommended to avoid such a procedure.

K. B.

Micro-Straining for Water Purification.—Until recent years, large-scale open strainers were not considered for any duty other than the removal, from flowing water of the larger floating and suspended solids. For the removal of finer suspended impurities, flocculation, sedimentation, and sand filtration were used, these processes being employed alone or in combination. Fine strainers could not be used except

for water with very low suspended content, due to the rapid blockage to which fine screens were subject. With the advent of automatic rotary type continuously self-cleaning strainers, it has become practicable to employ fine screens of the order of 100 to 150 mesh with apertures 142μ to 89μ. According to D. L. Boucher (*Engineer*, 1942, 163, 420-2, 445-7) it is now feasible to produce and use very much finer microstraining medium by controlled bright electro-plating of nickel on 325 mesh wire cloth. The original apertures in the 325 mesh of 39μ, can be plated down to 25 to 5μ, with a parallel increase in strength of the cloth and resistance to corrosion. From considerations of flow capacity and straining efficiency, the most effective aperture is found to be 15 to 25μ (average 20μ). For a river water containing not more than 2 parts per 100,000 of suspended solids, the "rating" for a 1" difference of level is 174 "vertical" feet per hour, compared with 19′ to 38′ per hour for rapid sand filters. The plated wire cloths can be used with waters with pH values 5·5 to 9·0, thus covering all ordinary natural and industrial waters. Arrangements are in progress for a standard self-cleaning rotary strainer of 100,000 gallons per hour capacity fitted with microstrainer cloth, to be installed by one of the largest English undertaking.

Public Health and Nutrition.—Writing in the *Indian Medical Gazette* (September 1942, 77, No. 7) W. R. Aykroyd says that there is no lack of evidence that nutrition is a factor of basic importance in public health. The first essentials for the prevention of disease are higher standard of health, a healthy physique and a greater power of resistance to infection. These can only be attained if food of the people is such as will give all the physiological and nutritional requirements of the human frame. Actually it is quite impossible to make any satisfactory quantitative assessment of faulty and insufficient diet as a disease-producing factor in India. Some light may however be thrown on the question by the study of available morbidity and mortality statistics.

At present there is very little accurate information about the causes of the high infantile mortality in India. As an example of how a deficient maternal diet may profoundly influence infantile mortality may be mentioned the incidence of high mortality in breast-fed infants, due to infantile beri-beri in the Northern Circars. In any ill-fed population group whether human or animal it is the newly born and the very young that suffer most severely from ill-effects of malnutrition. The causes of high infantile mortality in India have not been fully investigated. In this connection the observations of Hass (1940) in Java are significant. There is no reason to suppose that the state of nutrition of poor children in most parts of India is in any way better than that of children in Batavia, and the conclusion of Hass, that malnutrition is a major factor in causing disease and death in young children, can probably be applied to India. As regards maternal mortality, while a quantitative assessment is impossible it is reasonable to suppose that diet deficiency is responsible for much of the illness among pregnant women in India.

Regarding the relation between nutrition and various common diseases of India it may be of interest to note the effect of famine on birth rate, death rate and the influence of food scarcity and famine on the incidence of various diseases. A large percentage of the population in India lives on a diet which is defective in quality and often in quantity. It is not unreasonable to suppose that the incidence of diseases which become more prevalent in times of food scarcity is influenced by diet in normal times.

The vital statistics of India, inaccurate though they may be, provide clear indications that nutrition work is an essential part of public health activity. The improvement of diet is of essential importance if the goal of a healthy nation is to be attained.

Emergency Economies in Tin.—Both in the United States and in Great Britain every use of tin is scrutinised by groups of experts, in order to effect the utmost economy in the use of the very limited supplies of tin at present left to the United Nations. This is sought to be achieved not by a flat percentage reduction but by demanding the intelligent co-operation of every user, so that these economies are compatible with a minimum of reduction in the war effort. The Tin Research Institute, whose original object is to develop new and increased uses of tin, are now collaborating in devising methods and processes for the most efficient use of the available supplies. Thus the current number of *Tin and Its Uses* (No. 13), July 1942, discusses the advantages of thinly coated electrolytic tinplate as a substitute for ordinary tinplate and describes an automatic plant suitable for plating batches of standard sized sheets. Other articles on "Bearings with less Tin" and on "Economy of Tin in solder" deal with the same economy theme. Many of these efforts are besides bound to be of permanent value. Thus, instead of a normal plumber's wiped joint, it is found that lead pipes can be very effectively jointed by sweating with solder foil a pair of suitably shaped cup and cone ends and at the same time a 99 per cent. saving in tin effected.

Use of Colchicine in Preventing the Development of Plant Tumors.—Crown gall of apple, tumors on "paris daisy" have been the object of serious investigation by both pathologists and anatomists. The tumors greatly impair the vitality of the plant, and are caused by *Bacterium tumefaciens*. Recently, Brown (*Phytopathology*, 29, 221-31 and 32, 25-46) has shown that their development can be controlled, if not prevented by the use of colchicine. Young tumors on tomato, marigold, Bryphyllum and others were dusted with colchicine. After three or four weeks the tumors showed distinct shrinkage and actually disappeared in some cases. The same results were, however, not obtained by the use of the other chromosome doubling substances such as acenapthene, α-methylnaphthalene, α-nitronaphthalene and others.

M. J. T.

Palaeobotany in India.—The third number of the Progress Report (for the year 1941) on Palæobotany in India, published at Lucknow under the editorship of Prof. Birbal Sahni, F.R.S., which has just been issued, opens with an Obituary Note on the death of Albert Charles Seward, the doyen of palæobotanists "whose noble personality, no less than his vast learning, was a fountain-head of inspiration to the Indian School of Palæobotany". Then follows a brief account of recent work being done on plant fossils from several rock formations in India, arranged in the stratigraphical order, of which the following studies may be noted: "(*i*) "The microflora of some carbonaceous shales from the lower Gondwanas of the Mirzapur District, by Mr. K. R. Mehta (Benares); (*ii*) "The plant remains from the Triassic of the Salt Range", by Mr. R. V. Sitholey (Lucknow), including the first record of a pteridospermous microsporophyll from India; (*iii*) "The microflora of the Andigama (Ceylon) shale", by Miss Janet and Prof. Sahni (Lucknow), the composition of which is strongly in favour of assigning a Jurassic age to the containing beds, as has already been suggested on other grounds; (*iv*) The Cycadeoidea recently collected from the cretaceous beds near Ariyulur, Trichinopoly District, and being described by Dr. K. Jacob and Mr. N. K. N. Iyengar (Calcutta); (*v*) The petrified angiospermic flowers recently collected by Mr. V. B. Shukla (Lucknow) from the Deccan inter-trappean beds near Mohgaon Kalan which have been shown to belong to the same plant, the fruit of which was recently described by Prof. Sahni under the name *Enigmocarpon parijai*; (*vi*) The fossil algæ from (*a*) the Eocene beds of Assam, by Mr. K. S. Rao (Tumkur), containing two new species of *Archœolithothamnium*, and (*b*) The tertiary beds of N.W. Frontier Province, Sind, and Andaman Islands, by Mr. S. R. N. Rao (Bangalore); (*vii*) "The pleistocene flora from the Karewa beds of Kashmir", by Mr. G. S. Puri (Lucknow), which has been so far shown to contain 122 species belonging to 62 genera and 34 families of angiosperms, 6 species belonging to 5 genera of gymnosperms, and some ferns.

Tin Research Report.—In the Tin Research Institute's Report for 1941 it is stated that since Japan began the Far Eastern campaign the main problem has become one of how to make the best use of the supplies available, by curtailing the use of tin in commodities not essential to the war effort, by improving the processes in essential uses, and by recovering tin.

For these tasks, the experience accumulated by the Institute is invaluable, and it has been appointed by the Ministry of Supply to advise on all technical questions affecting the use of tin.

The Institute's hot-tinning plant was in continuous operation throughout the year, and much assistance was rendered to manufacturers in tinning some kinds of steel which have hitherto been difficult to tin.

Collaboration with manufacturers and with Government departments in the application of electro-tinning for parts of armaments was continued during the year, and there has also been considerable interest in electro-tinning for small soldering tags, terminals and clips. It will soon be possible to produce specially thinly coated tinplates, as a war economy measure, requiring only one-third of the tin used on normal tinplate.

Other sections of the Report review the progress made in research on tin-rich bearing alloys, foil and bronzes. Copies may be obtained free of charge from the Tin Research Institute, Fraser Road, Greenford, Middlesex.

Indian Central Jute Committee.—The Annual Report of the Committee for 1941-42 reveals that investigations during the year into the agricultural, technological, marketing and economic problems of jute have now reached an important stage. Noteworthy successes have been achieved in the official jute forecasts through improved sampling survey techniques developed under the technical guidance of Prof. P. C. Mahalanobis. Effective control measures have been evolved for the control of almost all the important insect pests of jute and are awaiting large-scale trials. By organising Grading Parties and Co-operative Jute Sale Societies, the farmers are now being educated in marketing their produces more profitably. The Committee's monthly organ, the Bulletin, containing available important trade and statistical information bearing on jute is getting increasingly popular and is published regularly.

Effect of Storage on Indian Vegetable Oils.—J. S. Aggarwal has made an interesting study of this subject (Industrial and News Edition of the *Journal of the Indian Chemical Society*, 1942, **5**, 121). It is found that although vegetable oils become more oxidised when stored in tin containers than when stored in glass ones, the changes are less than in the case of oils stored in plain steel vessels. However, ghee and tallow showed more oxidation in tinned containers, than in plain steel or glass ones. This may be true for all animal fats, as it has been found that this metal (tin) acts as an effective surface catalyst in the oxidation of lard.

Cork Substitute.—It is reported that cobs (cobs without grain) of the Indian maize (Zeemayes) form a good substitute for the corks if properly finished (L. D. Mahajan, *Science and Culture*, 1942, **8**, 139). These cobs are conical in shape, light in weight, and compressible in structure. The cobs are cut into pieces of desired length, their rough surface smoothed with sand paper and then they are soaked in molten paraffin for a minute or two. Corks so prepared have sufficient resilience as well.

Spark Testing of Steels.—The use of grinding sparks to identify steels is an established method and has been employed in steel mills for a number of years. The equipment required is simple; a portable grinder (a light one), a pair of safety goggles, and a set of

standard steels of known compositions. It is advisable to keep to a single type of wheel, sufficiently hard but soft enough to retain a free cutting face; and with normal pressure exerted on the wheel, its peripheral speed should be approximately 4,000 ft. per minute. Satisfactory results can be obtained with diffused daylight and a fairly uniform background.

L. P. Tarsov (*Iron Age*, 1942, 149, 39-43) has now shown how this art can be extended to classify scrap, and to be practised by less well-trained staff as well. The volume of the spark and the intensity of bursts are very characteristic. Stainless steel sparks are much shorter than those coming from low alloy and carbon steels, while most of the tool and die steels show the characteristic features associated with either a tungsten or high-chromium content material. A useful bibliography is appended.

Rectangular Plywood Containers.—"Owing to the fact that round containers take up much space in storage transit, a rectangular plywood container has been designed by the Forest Research Institute, Dehra Dun. The four sides are made of sheets of ordinary commercial 3-plywood. These are joined together by bent plywood corner pieces; rivets being used for fastening the corner pieces to the side sheets. The top and bottom of the container are of 7-plywood and are fixed in precisely the same way as in the round plywood containers described in Forest Research Institute Leaflet No. 24. All other fittings are the same as in the round containers. The corner pieces are very easily made with the aid of "V"-shaped male and female iron moulds, made from pieces of ordinary angle iron. The moulds are heated over a fire, or on a stove, until they attain a temperature of about 150° F. The veneers are then placed in the moulds (after applying casein cement as for making ordinary plywood), and pressed into shape. It is considered that these containers will be found suitable for greases, powders and solids in sizes upto 60 lbs., and for liquids, oils and paints upto 5 gallons."

Associateship in Sugar Technology.—The following candidates are declared to have passed the final examination for the Associateship of the Imperial Institute of Sugar Technology, (A.I.I.S.T.), held in July 1942. The names are in order of merit.

SECOND DIVISION: (1) Phanindra Bhusan Bhattacharjee, (2) Bimalendu Chakravarty, (3) Shaukat Hussain Ansari, (4) Sushil Kumar Bose.

University of Ceylon.—The first Convocation of the University of Ceylon was held on the 14th October 1942, at the University College, Colombo, with all the customary ceremonial and dignity associated with such events. Besides the Chancellor, H. E. the Governor of Ceylon, and the Vice-Chancellor, Dr. Ivor Jennings, there were seven other distinguished recipients of Honorary Degrees of the University. Two of them were drawn from the Buddhist Order and honoured for their Oriental learning. Two eminent Indians, namely, Sir S. Radhakrishnan, Vice-Chancellor of the Benares Hindu University, and Dr. A. Lakshmanaswamy Mudaliar, Vice-Chancellor of the Madras University, were conferred the Degree of Doctor of Laws (*in absentia*). This gesture of admiration for Indian scholarship must contribute towards fostering a closer cultural relationship between the two neighbouring countries.

Bauxite Deposits in South India.—The presence of important deposits of bauxite in the Shevaroy Hills in South India has been revealed as a result of investigations carried out by the Geological Survey of India following on preliminary work by a local prospector. The numerous analyses made show that the ore is of good quality, containing a high percentage of alumina.

Indian Central Cotton Committee.—There has been an erroneous announcement in the note on the monsoon meeting of the Indian Central Cotton Committee, as published in *Current Science* (September 1942, 11, No. 9, p. 381, left column, para 4, line 5). The pilot plant for production of chemical cotton will be located in the compound of the Technological Laboratory of the Indian Central Cotton Committee, and not in the precincts of the new Bombay University Technological Laboratories.

SEISMOLOGICAL NOTES

During the month of September 1942, two slight earthquake shocks were recorded by the Colaba seismographs as against two slight and eight moderate ones recorded during the same month in 1941. Details for September 1942, are given in the following table:

Date	Intensity of the shock	Time of origin I. S. T.	Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
		H. M.	(Miles)		(Miles)	
3	Slight	14 14	1800	..	..	..
24	Slight	10 09	3140	..	..	Epicentral region probably located in the Sulu Sea.

MAGNETIC NOTES

Magnetic conditions during September 1942 were less disturbed than in the previous month. There were 13 *quiet* days, 16 days of *slight* disturbance and one of *moderate* disturbance as against 6 quiet days, 18 days of slight disturbance, 5 of moderate disturbance and one day of very great disturbance during September 1941.

The quietest day during September 1942 was the 28th while the 12th was the day of largest disturbance.

The individual days were classified as shown below.

Quiet days	Disturbed days	
	Slight	Moderate
3-5, 7, 9, 10, 23-26, 28-30	1, 2, 6, 8, 11, 13-22, 27	12

No magnetic storm was recorded during September 1942 while 3 storms, two of moderate intensity and one of very great intensity, were recorded during September 1941.

The mean monthly character figure for September 1942 was 0·60 as against 1·00 for the same month last year.

A. S. CHAUBAL.

ANNOUNCEMENTS

The Government of India have for some time been considering the question of revising the present method of control of imports of drugs and medicines from abroad to ensure that only the most suitable medicines and in the most suitable quantities are imported under the Import Trade Control Scheme. They have now decided to set up for the purpose an Advisory Panel on drugs and medicines with the following terms of reference: "To advise the Government of India as to which drugs and medicines, other than those the formulas of which are included in the official pharmacopœias of the exporting countries, it is essential to import into India from abroad."

(The term 'Official Pharmacopœias' includes the British Pharmacopœia, the British Pharmacopœia Codex, the United States Pharmacopœia, and the National Formulary of the United States of America.)

The Panel will consist of officials and non-officials and will include representatives of the drug trade and industry as well as medical and scientific experts. Its work will largely be conducted by correspondence. Ultimately, however, it will meet at the headquarters of the Government of India when a state of final decision has been reached. The following are the members of the Panel: (1) Brevet Col. Sir R. N. Chopra, C.I.E., I.M.S. (Retd.), Director, Drug Research Laboratory, Jammu and Kashmir State (*Chairman*); (2) Dr. B. N. Ghosh, M.B.E., F.R.F.P. & S. (Glas.), L.M. (Dublin), F.S.M.F. (Bengal), F.R.S. (Edin.), Professor, Carmichael Medical College, Calcutta; (3) Lt.-Col. G. R. McRobert, M.D., C.H.B., D.T.M. & H., I.M.S., Government General Hospital, Madras; (4) Dr. W. R. Aykroyd, M.D., Director, Nutrition Research Laboratories, Coonoor; (5) Sir Hari Shanker Paul, C/o Messrs. B. K. Paul and Co., Ltd., Calcutta; (6) E. B. Fairbrass, Esq., M.P.S., General Manager, Messrs. Keap & Co., Bombay; (7) Dr. B. Mukerjee, D.Sc., M.D., F.A.Ph.S., Director, Biochemical Standardisation Laboratories, Calcutta.

* * *

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"Journal of the Royal Society of Arts," Vol. 90, Nos. 4617 and 4618.

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"Biochemical Journal," Vol. 36, Nos. 1 and 2, and 3 and 4.

"Journal of the Indian Chemical Society," Vol. 19, Nos. 7 and 8.

"Indian Forester," Vol. 68, No. 10.

"Mysore Information Bulletin," Vol. 5, No. 8.

"Review of Applied Mycology," Vol. 21, Part 6.

"The Mathematics Student," Vol. 10, No. 1.

"Journal of the Indian Mathematical Society," Vol. 6, No. 2.

"Indian Medical Gazette," Vol. 77, Nos. 7 and 9.

"Nature," Vol. 150, Nos. 3793-3795.

"Indian Journal of Physics," Vol. 16, Parts 3 and 4.

"Canadian Journal of Research," Vol. 19, No. 9.

"Science," Vol. 95, Nos. 2473, and 2478.

"Sky," Vol. 1, No. 8.

"Science and Culture," Vol. 8, No. 4.

"Indian Trade Journal," Vol. 146, Nos. 1891-1892; and Vol. 147, No. 1893.

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Fundamentals of Vibration Study. By R. G. Manley. (Chapman & Hall, London), 1942. Pp. xii + 128. Price 13*sh.* 6*d.*

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CURRENT SCIENCE

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NEWTON AND THE HISTORY OF OPTICS

THE 25th of December 1942 is the three-hundredth anniversary of the birth of Isaac Newton, discoverer of the law of universal gravitation and one of the greatest figures in the history of science. Newton's fame rests most securely on his great work "*Principia Mathematica Philosophiæ Naturalis*". In this work Newton developed a system of mechanics on broad foundations and opened up many new fields of knowledge. In particular, he laid the basis of dynamical astronomy including especially planetary and lunar theory, the theory of the figure of the earth and the theory of the tides, as also of hydrodynamics and the theory of sound. The magnitude of the scientific achievements embodied in the *Principia* of Newton has been described by Lenard in the following words:—

> "If we open the book in order to examine it in detail, we are astonished, quite apart from the main discovery, by every part of it, and overwhelmed with admiration for the greatness, the extent, the power, as well as the fineness of structure, of what he erects upon the foundations given by Pythagoras, Archimedes, Leonardo, Stevin, and in particular Galileo and Huygens using the material afforded by Copernicus, Tycho and Kepler, and the tools provided by mathematicians from Euclid to Descartes, with very essential additions of his own. We are not less astonished and almost overwhelmed, by the countless number of single achievements, which, from whatever side the work is regarded and studied, are revealed to any one capable of comprehending them. The whole, when we consider the richness of its contents, the general and detailed form, and the impression it makes of towering greatness, can only be compared to a grand old Gothic cathedral: one stands in front of it filled with astonishment, absorbed in gazing at it, and without words to express one's impressions. Great cathedrals were built in numbers by the masters of Gothic, but among the works of men of science, Newton's *Principia* is unique of its kind."

The two years 1665 and 1666 which Newton spent at his country home of Woolsthorpe after taking his Bachelor's degree at Cambridge appear to have been the formative period of his youthful genius. To these two years have been traced back his fundamental discovery of the spectral character of white light, his invention of

the fluxional calculus, and his first conception of the universal law of gravitation. The recognition of Newton's transcendent abilities fortunately also came quickly, for in 1669 when he was only twenty-seven years of age, he was called to the Lucasian Professorship of Mathematics at Cambridge. In the years that followed and which were passed quietly at Cambridge, Newton published much of his work on optics and developed his thoughts on gravitation. The writing of the *Principia* was completed in 1684 and the work appeared in print in 1686. Newton's major scientific activities practically terminated in 1692. The later years of his life were spent in London in the discharge of his official duties as Warden and later as Master of the Mint. He was President of the Royal Society of London from 1703 till his death on the 20th of March 1727. Newton was buried in Westminster Abbey.

While Newton appears as a mathematical philosopher in his *Principia,* he is essentially the practical experimentalist and observer in his optical investigations which had as their starting point his desire to construct improved forms of astronomical telescope. Newton's approach to the subject is clearly stated in the opening words of the first book of his *Optics* which disclaim any desire to explain the properties of light by the aid of hypotheses. The reprint of the fourth and final edition of the book issued in 1931 makes Newton's work on the subject conveniently accessible to readers of the present day. The first book in the treatise sets out in full detail his observations on the spectral composition of white light and its consequences. The second book deals with the colours of thin and thick plates and their interpretation. The third book contains some evidently incomplete observations on what we would to-day call the diffraction of light by obstacles and narrow slits. The work terminates with the famous queries, thirty-one in all, in which Newton wrote down his thoughts on a wide range of topics.

As is well known, Newton favoured a corpuscular view of the nature of light. Indeed, he made it quite clear in his treatise that he rejected the wave-concepts of light advanced by Robert Hooke in his *Micrographia* (1665–67) and by Christian Huygens in his celebrated *Traite de la Lumiere* (1690). As is also well known, this had unfortunate consequences for the progress of optical science, Newton's great authority having kept back the inevitable triumph of the wave-theory of light by well over a century. The specific objection raised by Newton to the wave-theory of light in his query 28, namely that light does not bend into the region of shadow of an obstacle, was clearly based on an incomplete knowledge of the facts. This would, no doubt, have become evident to Newton himself if he had continued the experiments described in the third part of his book and approached the subject with an open mind. There has been a tendency in recent times to find some support for Newton's attitude towards the wave-theory of light in the recent revival of corpuscular ideas and even to find in his hypothesis of "fits" of easy reflection and transmission, a resemblance to the ideas of the quantum mechanics. It is sufficient to remark that it is precisely the phenomena of the kind de-

scribed in the second and third books of Newton's optics that form the strongest bulwarks of the wave-theory of light, and that the corpuscular aspects of the behaviour of light do not enter in the interpretation of these phenomena. Indeed, it does not seem easy to discover any real justification for Newton's rejection of the ideas advanced by his contemporaries Hooke and Huygens in explanation of the facts of optics known in their day.

C. V. Raman.

JOURNAL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The *Journal of Scientific and Industrial Research*, the first number of which has just appeared, "is intended to place before the scientists and the lay public the results of various researches carried on from time to time and to stimulate both the scientists and industrialists to further efforts in research on the one hand and the utilisation of research on the other". It will provide a vehicle for the publication of results of all the researches sponsored or undertaken by the Board of Scientific and Industrial Research and "induce *entrepreneurs* to invest in industrial ventures in the secure knowledge that scientific help will be available to them in the teething stages of their industry".

In this country, there has been so far no effective organisation intended to establish a close and sympathetic understanding between Science and Industry which is so essential for a rapid and balanced development of both these branches of human endeavour. We have every confidence that this journalistic enterprise, which is guided by an Editorial Board of distinguished scientists and industrialists in this country and piloted by an able, experienced and talented editor, will serve to fulfil this vital function. We wish to offer a hearty welcome to the Journal and wish it a long and bright career of useful service in the cause of Science and Industry.

HIS EXALTED HIGHNESS THE NIZAM, ON INDUSTRIAL DEVELOPMENT

In the course of an important Address which H. E. H. the Nizam delivered on the occasion of the opening of the Fifth Hyderabad Industrial Exhibition, His Exalted Highness drew the attention of the audience to the fact that owing to the war, the import of certain kinds of goods had ceased; this had created opportunities for manufacturing these goods in India and develop local industries. He continued, "It is our duty to make the most of such opportunities to make our country self-sufficient, and promote its needs. It would be a good thing if every one were to resolve to supply his necessities of life from goods manufactured in the country and buy only those articles from outside which were not manufactured here. In fact, even as regards these latter he should consider why they should not be made in India. My Government are not unaware of the opportunities presented, due to the war, of establishing certain types of industry here. They are in fact, trying to absorb as much local raw produce as possible in local industries for the financial benefit not only of the manufacturers but also of poor cultivators, who grow this raw material and labourers who work in factories.

"The industrial history of every nation bears witness to the fact that only those countries have advanced which have taken advantage of their opportunities, while those who wasted their time in mere reflection and achieved nothing practical, have lost ground, and have been left behind in the race by other more enterprising nations." His Exalted Highness added that it was in the interest of, as well as the moral duty of capitalists to prepare schemes for the manufacture of goods in demand in India and seek facilities and advice from the Government. In this way they would be able to reduce unemployment.

RESEARCH IN ECONOMIC SCIENCE

BY

PROF. P. J. THOMAS

(*University of Madras*)

RESEARCH in Economics is fundamentally different from research in the physical sciences. Being concerned with inanimate nature, the physical sciences deal with problems which are fairly common the world over, and therefore research in those sciences wherever conducted has a world-wide interest and goes into the world pool. But Economics is concerned with human beings, who, thanks to the free will with which they are endowed and also to racial and climatic differences, have developed institutions varying from country to country, and therefore the problems before economists in each country differ to a large extent. In the last hundred years, Western Europe and North America have developed a predominantly industrial civilization, and the economists in that part of the world have evolved a science of economics deduced from the facts obtaining there. Asia has indeed been greatly influenced by such developments in the West, but till lately the result has been that Asiatic economy had to adjust itself on a complementary relationship with the Western. While the West by utilising the remarkable technological advance in the 150 years has become the world's manufacturer, the more backward countries in Asia and America grow the raw materials and foodstuffs needed to feed the mills of the West and the men that work in them. There are also fundamental differences not only in economic but in social life between the West and East. All this has made the economic problems in India very different from those of the West, and economists in this country are concerned primarily with those problems.

There is indeed a substratum of theory which forms the core of economic science and which is of universal validity. The central point of this theory is value and exchange. Formerly this theory was formulated as rough hypotheses or generalizations and did not claim any great precision. Attempts have lately been made to formulate this theory more precisely by using mathematical tools and technique. In the first flush of enthusiasm, some thinkers claimed that with the help of such tools, a new positive science of economics with no relation to practical policy could be built up. While this claim has proved too optimistic, it must be admitted that the application of mathematical methods, especially statistics, has made the study of practical problems more precise, and has enabled economists to help more effectively in the formulation of public policy. The old Political Economy which was a compound of science and art has thus given birth to econometrics, a comparatively more accurate science using mathematical tools and building conclusions on the basis of the statistical measurement of economic phenomena. The new science bases itself upon facts and therefore the collection of statistics is of great importance. The old style of economic writing, consisting mainly of vague generalizations, is now at a discount. This has opened to the earnest student a new vista of advanced research. Economics has also become fruit-bearing in a more real sense that formerly, and a science of economic engineering is now growing. This has also facilitated the work of Government authorities in that their policies could be more carefully laid down, and pursued more systematically, watching the results periodically by means of statistical measurement. Economics is thus coming into its own, and this has enabled economists to be of greater use to their fellowmen. It is now possible for them to help substantially towards what Dr. Marshall considered as the supreme goal of economic studies—the eradication of poverty.

But in India there are great difficulties in carrying out such econometric studies. Firstly, we have not enough statistical data regarding our economic phenomena; nor are the available data of any high degree of accuracy. Our figures of external trade are perhaps the most accurate, but we have no data regarding our large internal trade which must be at least fifteen times as large as our external trade. Our census gives figures of population, and even these have not lately been very accurate owing to the abnormal play of political considerations. The 1941 census was a great improvement on the previous censuses from the economic point of view, thanks to the scientific flaire of the Census Commissioner,

Mr. Yeatts; but the war having intervened, the tabulation of the occupational tables has been shelved, and only the bare facts of population increase are available to us. Statistics of production and national income are of great importance to the economist; but as things are, reliable figures cannot be had in India about either of these. It must be admitted that fairly accurate information regarding agricultural production, at any rate relating to the chief crops, is available, because such data happen to be important in this country for revenue purposes; in fact in regard to the chief commercial and food crops of India, our statistics can be compared with those available in the foremost countries of the West. But a large number of minor crops have been left out. As for industry, some statistics of production in establishments coming under the Factories Act are available, but the figures are not complete, and it is hoped that the Industrial Statistics Act lately passed by the Government of India will mark a great improvement. These establishments, however, employ only 1½ million labourers out of the 40 odd million industrial workers in India; and we have little information regarding the production of the numerous labouring population engaged in handicrafts. Much the largest of these handicrafts—the hand-weaving industry—was lately surveyed by a Committee of the Government of India; and having been in charge of that enquiry, I am able to say that information regarding an industry employing about four million people and supporting about ten millions is very insufficient. Prices and wages form a very important part of a country's statistics, and data regarding these must be continuous, if they are to be useful; but the existing information is very meagre and not suited for proper economic analysis. The collection of grain prices has always been the concern of the Government, especially in Provinces like Madras and Bombay where land revenue is periodically re-settled; and it is a fact worth noting that in Madras we have an uninterrupted series of prices of food-grains from the year 1800 onwards. The price statistics of Government are indeed valuable, but unfortunately the prices taken have not been from the cultivator's end, and therefore their usefulness is marred. Regarding the part of the national income going to trade, transport and the numerous miscellaneous services—a considerable item in other countries—we have hardly any information.

The primary data available being so meagre, economic research is seriously handicapped; and in the result some students adopted the easier path of making generalizations regarding economic problems and thus lent themselves to the criticism of political prejudice. Others patiently took up the laborious task of collecting primary data by means of economic surveys of village and urban conditions. Dr. Slater in Madras, Dr. Mann in Bombay and Mr. Jack in Bengal did pioneering work in this line and this has been followed up by Indian workers all over the country and in some Provinces by official Boards of Economic Enquiry. In Madras, we have resurveyed, after 20 years, the villages originally surveyed under Dr. Slater, and have analysed from the results the trends of change during the eventful years between the first survey (1917) and the second (1937). At any rate this will serve as a landmark for the economic historian. The critic cavilling at such studies on the ground that this is not economic theory must be told that without such minute collections of primary data economics will remain mere arm-chair theory and the economists cannot be helpful in directing public policy.

Such is the field before the research worker in economics, a field where laborious pioneering work is called for. The existing data are altogether inadequate and lacking in accuracy. Therefore the student in India will have to work harder than elsewhere till the factual foundations are properly laid. The facts of agriculture, industry, trade and transport must be collected and interpreted; none of these economic activities are in a very prosperous condition in India, owing largely to the prevalence of various evils of organization and functioning. Owing to such evils the national income of the country is at a rather low ebb, and consequently the standard of living of the masses is extremely low. The central problem of Indian economy is to increase production by tackling all these evils frontally and to see that the increased production is equitably distributed as between the different economic groups and individuals. A band of research workers is required if such a colossal task is to be carried out. There are also attractive avenues of research in economic history—nearly a virgin-field—which calls for workers. There are in India vast archives

still to be explored. Especially in Madras, the Government records are a marvellous collection dating right back to the 18th century, and we have here an immense field for fruitful research. Of course workers in this field may not have the limelight which those who investigate current problems sometimes receive, but their names may shine more brilliantly in the eyes of posterity.

There are also other impediments to the progress of research. One is that the degree courses in the universities do not give a proper equipment to the student, with the result that the post-graduate worker needs a longer period of training than in Western countries. A training in statistical methods is essential for research in economics, but no provision is made for this subject in the economic courses of most universities. Owing to the wide disparity in this country between emoluments in the civil service and other salaried posts, the great majority of bright students prefer the civil service and are lost to research. As every one knows, this is not true of England or America, where the best students cannot be thus enticed by the civil services. The university teacher in the West has a prestige which is denied to his confrere in India; nor are Government offices so ready here as in the West to give assistance to research workers.

The British civil servants who came to India after training at Haileybury College under teachers like Robert Malthus a hundred years ago took great interest in the study of the economic problems of this country, but to-day the average civil servant in India confines himself to administrative duties, largely because the scope of such duties has greatly increased in recent times. The administrator should at least keep in touch with the studies bearing on his official duties; but one fears that there is an inclination on the part of the average administrator to take scant notice of the writings of academic workers, an inclination which is not in the best interests of the country. If it is admitted that advanced studies in Economics will throw some light on thorny questions of public policy, it stands to reason that every effort should be made by Government to encourage such studies and make them fruitful by rendering available to the advanced student all the data which are in Government's possession. Of course, the research worker too must deserve such help by making his studies objective and keeping clear of political and social prejudices. There is to-day in India a large scope for fruitful research in economics and it is hoped that such studies will make rapid strides forward in the years to come.

FREEDOM OF THE PRESS

A DISPUTE has recently arisen between members of the Association of Scientific Workers and the management of a London drug and chemical manufacturing firm. Scientific employees of the firm were asked to sign an additional "Condition of Employment" contract which included the clause: "I agree that I will not, without previous consent, publish books or articles, whether such be for remuneration or otherwise." Members of this firm had arranged to supply (for payment, we trust) a regular science feature to the local newspaper and they sought clarification of the new clause as it affected this. The management stated that consent would have to be obtained before publication. Moreover the employees were informed that it would be considered obligatory for them to submit other matters such as letters to *The Times* on non-scientific subjects, to the management before publication.

The A Sc W. quite properly take the view that the clause referred to could be interpreted to mean that the employee gives up the right of publication of personal views and opinions upon matters quite unrelated to the business affairs of the company. In reply, the management have stated that they intend no infringement of the civil liberties of their employees unless their business interests are affected.

Important principles are involved, the main being the right of an employee, scientific or otherwise, to express his opinion on all subjects irrespective of the views and wishes of his employers. This perticular liberty must be guarded by all workers and we trust that the A Sc.W. will obtain the whole-hearted support of all professional orginizations in any steps it may take to ensure the freedom of the press.

Chemical Products, 1942, p. 57.

LETTERS TO THE EDITOR

TACTICAL CONFIGURATIONS AND THE METHOD OF SYMMETRIC DIFFERENCES

A TACTICAL configuration may be defined as a finite aggregate of sets of elements combined according to given symmetrical principles. It is no wonder that such configurations occur almost everywhere in mathematics. Fisher and Yates[1] have now discovered a new use for them in the design of agricultural experiments. Various methods have been devised for the construction of particular types of configurations, centering round finite geometries, marks in the Galois field, multiply-transitive groups, and more recently the so-called symmetric differences. A little history of this last method is worth giving in this connection.

About 1931, when I struck upon a method of differences to set up finite geometries and discovered a few related theorems, I wrote to Professor Veblen, then of Princeton University, to give me some references. I quote below a few lines from his letter, dated October 7, 1931:

"With regard to the questions raised in your letter, I would say that I think you will find the theorem mentioned in your question number 2, in some of the books on Combinatorial Mathematics, for example, in Netto's book. At any rate I remember that I used the method of differences to set up finite spaces before I knew about the Galois field method.

"In general, I have no doubt that there are a great many finite spaces which are not obtainable by the use of Galois field method. One of my colleagues constructed examples of such spaces by laborious trial and error methods long ago. It would be interesting to get something systematic on this subject."

Not satisfied with the above vague reply, I announced my method of differences in a paper on "Finite Geometries" read before the Nineteenth Session of the Indian Science Congress, Bangalore, 1932. On page 105 of the Abstracts,[2] mention is made of the existence of modular sets of the type $(X_1, X_2, \ldots\ldots X_n)$: mod. $(n^2 - n + 1)$, where $X_r < X_{r+1}$ and the differences $X_r - X_s$, mod. $(n^2 - n + 1)$, are all distinct. Such sets may be briefly referred to as modular difference sets. For example, the set $(1, 2, 4, 9, 13, 19)$; mod. 31 gives rise to a finite projective geometry of 31 points and 31 lines with six points in each line, and six lines through each point. Statistically, this represents a balanced incomplete block design of six experimental units, with thirty-one blocks, and thirty-one varieties.

In 1938, James Singer announced a method of obtaining modular difference sets from the

Galois field theory and utilised it to give a compact combinatorial representation of a plane finite projective geometry—just the same representation that I had given seven years previously and about which Veblen had remarked dubiously that it might be found in books on Combinatorial Analysis, like Netto's. Netto's book is unfortunately not accessible to me and in the recent articles of R. C. Bose, which refer to Netto's Combinatory Analysis,[4] Veblen's Finite Geometries and Singer's difference properties,[3] there is no indication of the method of differences being specifically employed in Netto's work.

A general method of discovering all possible difference sets is yet to be devised, while the problem whether every finite geometry or randomised block arrangement implies a modular difference set, is unsolved, though the converse is now known to be true. All the methods so far known about the construction of tactical configurations involve somewhere an element of guess work which seems to be unavoidable. However, the recent collections of examples of configurations due to Archibald, Fisher, Yates, Stevens, Bose and others provide some basis for the outlines of a general theory.

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Maharaja's College,
Mysore,

December 11, 1942.

1 Fisher and Yates, "Statistical Tables for Biological, Agricultural and Medical Research," 1938.

2 "Proceedings of the Nineteenth Indian Science Congress," Bangalore, 1932.

3 Bose, R. C., *The Journal of the Indian Mathematical Society*, 1942, **6**, 1.

4 —, *Annals of Eugenics*, 1939, **9**, 4.

PHOTOELECTRIC EFFICIENCIES OF SOME METALS IN THE SOFT X-RAY REGION

THE photoelectric efficiencies of some metals in the soft X-ray region were studied by Davies[1] and Bandopadhyaya[2]. The latter author investigated the efficiencies of 11 elements for soft X-rays excited at 400 volts from a copper target. The order of efficiency was found to be very similar to that under ultra-violet light.

This resemblance between the photoelectric properties due to soft X-rays and ultra-violet light has also been suggested from the similarity in the absorption coefficients in the 500-volt soft X-ray region and in the ultra-violet region, found by Rudberg[3] and Partzsch and Hallwachs[4] respectively.

In the present investigation, this similarity has been extended by a study of the photoelectric efficiencies of Zn, Cd, Sn, Pb, Al, Mg, Ag, Ni, Co and Fe. The last few metals were studied so that the results may be compared with those of previous workers.

Millikan and Winchester[5] have studied the photoelectric efficiencies of some of these metals for ultra-violet light and gave the order Pb, Zn, Mg, Al, Fe, Ag and Ni.

Soft X-rays produced from a thoroughly outgassed nickel plate and freed from ions by a condenser arrangement, were allowed to fall on freshly degassed metal surfaces for the study of their photoelectric efficiencies. Four metals were used in one setting, these being arranged in the form of a lantern, with the degassing filament enclosed within the structure. The photoelectrons liberated were attracted to an external shield raised to a positive potential and the photoelectric current was measured by allowing it to leak through a high resistance, one end of the resistance being earthed and the other end being connected to a quadrant electrometer. The high resistance was made of a smoked quartz rod and had a resistance of about 10^{11} ohms. The experiments were carried out in high vacuum, the pressure inside the pyrex working tube being much lower than 10^{-6} mm. of mercury.

The metals could be arranged in the following order of decreasing photoelectric sensitivity:—Zn, Cd, Sn, Pb, Al, Mg, Ag, Ni, Co and Fe. This agrees well with the order given above by Millikan and Winchester[5] for some of these metals.

The following figures give the values of the work function of the metals, wherever these

are very reliable, taken from Hughes and Dubridge.[6]

Photoelectric work function (in volts).—Zn: 3·32-3·57, Pb: 3·5-4·1, Al: 2·5-3·6, Mg: 3.4, Ag: 4·73, Ni: 5·01, Fe: 4·72.

It is interesting to observe that the first four metals fall into one group and that the last three metals form another group. For the first group, the photoelectric sensitiveness is relatively large and the work function small. For the second group, the work function is comparatively large and the photoelectric efficiency correspondingly small. The photoelectric efficiency of a metallic element seems to depend not on its atomic number but on its work function.

Reference may be made to the changes of photoelectric sensitivity with change in the photoelectric threshold, observed with iron by Cardwell[7] using ultra-violet light and Rao and Sankarasubba Iyer[8] using soft X-rays.

Full details will be published elsewhere.

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K. K. Ramamurti.
Annamalai University,
Annamalainagar,
December 5, 1942.

[1] Davies, *Proc. Roy. Soc.*, A, 1928, **119**, 543.
[2] Bandopadhyaya, *Ibid.*, A, 1928, **120**, 46.
[3] Rudberg, *Ibid.*, A, 1928, **121**, 385.
[4] Partzsch & Hallwachs, *Ann. der. Phys*, 1913, **41**, 247.
[5] Millikan & Winchester, *Phil. Mag.*, 1907, **14**, 188.
[6] Hughes & Dubridge, *Photoelectric Phenomena*, 1932, 442.
[7] Cardwell, *Proc. Nat. Acad. Sci.*, 1928, **14**, 439; and 1929, **15**, 544.
[8] Rao & Sankarasubba Iyer, *Proc. Ind. Acad. Sci.*, A, 1941, **13**, 411.

PARACHOR AND LATENT HEAT OF VAPORIZATION

The latent heat of vaporization $l = \frac{5\cdot7\ T_b}{V_0 D_c}$, where T_b is the absolute boiling point, V_0 is the zero volume at the absolute zero and D_c is the critical density.[1] Further, $V_0 = \frac{[P]}{2\cdot873}$, where [P] is the parachor.[2] Since $V_0 = 0\cdot27\ V_c$,[3] $D_c = 0\cdot27\ D_0$, where D_0 is the density of the supercooled liquid at the absolute zero. Substituting the values of V_0 and D_c in the above equation,

$$l = 60\cdot7\ \frac{T_b}{[P]\ D_0}. \qquad \text{(i)}$$

The values of D_0 can be obtained from the equation

$$D_0 = \frac{D - d}{(1 - T_r)^{3/10}},$$

where D and d are the densities of the liquid and vapour respectively at the reduced temperature T_r.[4]

Substituting this value of D_0 in (i), $l = \frac{60\cdot7 T_b\ (1-T_r)^{3/10}}{[P]\ (D-d)}$. According to Guldberg-Guye law, $\frac{T_b}{T_c} = 0\cdot66$ for a large number of normal substances. Hence,

$$l = \frac{44\ T_b}{[P]\ D} \qquad \text{(i } a\text{)},$$

where D is the density of the liquid at its boiling point; d the density of the vapour is usually small and may be neglected. Evidently, (i) is more accurate than (i a), but the latter deals with a value of density which is more easily available.

Another relation between parachor and latent heat of vaporization has been deduced. Herz[5] has shown that the product $\frac{p_c V_c}{T_c}$ has the same numerical value as the Trouton constant $\frac{Ml}{T_b} = 21$, when the critical pressure p_c and the critical volume V_c are expressed in atmospheres and c.cs., respectively. The author has given a relation[6] $\frac{p_c\,[P]}{T_b} = 1952$ (cm.c.cs.). So,

$$0\cdot818\ \frac{p_c\,[P]}{T_b} = 21 \text{ (atm.c.cs.)}$$

Equating the two expressions, we have

$$Ml = \Delta H_m = 0\cdot818\ p_c\ [P], \qquad \text{(ii)}$$

where ΔH_m is the molal heat of vaporization.

The accompanying table incorporates the observed and calculated values of l for some normal liquids, by both the equations given above (i) & (ii). Associated liquids, however, do not obey these equations. The observed values of l are taken from literature.

Substance	l observed	l calculated by equation	
		(i)	(ii)
Carbon tetrachloride	46·8 cals.	46·6 cals.	52·6 cals.
Ether	84·5 ,,	90·5 ,,	83·2 ,,
Stannic chloride ..	30·5 ,,	31·3 ,,	31·7 ,,
Ethyl acetate ..	86·3 ,,	85·8 ,,	76·6 ,,
Benzene	95·4 ,,	92·1 ,,	103·7 ,,
Chlorobenzene ..	75·0 ,,	74·3 ,,	79·3 ,,

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Bombay,
November 17, 1942.

1 Herz, *Z. anorg. Chem.*, 1926, **153**, 269-72.
2 Sugden, *J. Chem. Soc.*, 1927, 1783.
3 —, *Ibid.*, 1784.
4 —, *Ibid.*, 1781.
5 Herz, *Z. Electrochem.*, 1919, **25**, 321.
6 Telang, *J. Indian Chem. Soc.*, 1942, **19**, 366.

CHROMATOGRAPHIC REMOVAL OF THE GROWTH-PROMOTING FACTORS FROM NATURAL GLYCERIDES

IN the course of our studies on the sterol requirements of the rice moth, *Corcyra cephalonica* Staint, it was considered necessary to employ a basal diet free from sterols but not free from glycerides. The preparation of such a diet offered difficulties because (1) all natural glycerides are associated with some type of sterol or another, (2) usual method of separating sterols from the oil (saponification) involves the destruction of the glyceride and often brings about a change in the structure of the unsaturated fatty acids, (3) there is no selective solvent by means of which a quantitative separation of the sterol could be effected either from the oil or from the diet. Both the sterol and the oil get simultaneously extracted to a greater or lesser extent, by all types of available solvents. An approach towards a solution of the problem is to be therefore sought either in finding a method by which the sterol could be quantitatively removed from the natural oil by a purely physical method, which will not bring about any change in the chemical composition of the glyceride, or in employing a synthetic glyceride as the source of fat in the basal diet.

Preliminary trials showed that chromatographic treatment of the natural glyceride would prove successful not only in securing an oil of sufficient purity (freedom from growth-promoting factors) but also in yielding a chromatographed column from which the sterols could be eluted by a suitable mixture of solvents. Brockmann's alumina (Merck) was found to be a satisfactory adsorbent for this purpose.

Groundnut oil (Syn.:—Arachis or peanut), which had been previously used in connection with our studies on insect nutrition, was found to exhibit varying degrees of growth-promoting activity depending upon the batch of the sample (obtained through the kind courtesy of the Vegetable Oil Products Company). During the process of refining, the oil, batches of which might vary in their initial sterol content, was not obviously deprived of its sterol to the same extent. A systematic purification of the groundnut oil was, therefore, undertaken with a view to obtain an oil free from growth-promoting sterol fractions. The oil diluted with an equal volume of petroleum ether (40°-60° C.), was passed through a previously prepared chromatographic column of alumina. The filtrate was passed a second time through another fresh column and the filtrate resulting from this, through a third column. Aliquots from the three filtrates together with the original solution of the oil in petroleum ether, were biologically assayed for their growth-promoting activity by employing the 16-day old larvæ of the rice moth. These larvæ had been fed on whole jowar for the first ten days and subsequently on chloroform-extracted jowar for the next six days. Chloroform-extracted jowar constituted the basal ration to which a given amount (4·28 per cent., corresponding to the percentage of chloroform extract of jowar) of each of the fractions was added and the diet

prepared. Insects in batches of five larvæ were weighed. The results are given in Table I.

periods; they respond quickly and vigorously to additions of the elutate to their diet.

TABLE I

Diets	0 days	13 days	21 days	Survivals	Recuperative Capacity of the Experimental Larvæ		
					Larvæ transferred on the 21st day to the following diets	35 days	44 days
A. Whole Jowar (a)	7·87	101·76	143·59	7 out of 7	Same Diet	All pupated (2 moths)	3 moths
(b)	6·79	65·74	143·07	6 ,, ,, 8	,, ,,	,,	,,
B. Chloroform-extracted Jowar (a)	8·01	38·41	62·83	8 ,, ,, 8	Whole Jowar	All pupated (2 moths)	6 moths
+ Groundnut Oil (b)	7·28	35·54	65·64	8 ,, ,, 8	Same Diet	All pupated	4 moths
C. Chloroform-extracted Jowar (a)	8·10	15·43	15·34	9 ,, ,, 9	Whole Jowar	93·86	All pupated
+ 1st Filtrate (b)	7·34	11·76	14·00	8 ,, ,, 8	Same Diet	23·63	23·11
D. Chloroform-extracted Jowar (a)	8·15	—	—	—	—	—	—
+ 3rd Filtrate (b)	7·70	12·11	10·94	6 ,, ,, 8	Groundnut Oil Diet	4·10	89·05
E. Chloroform-extracted Jowar (a)	8·64	10·68	8·96	4 ,, ,, 8	Whole Jowar	80·43	193·23
(b)	7·41	8·04	6·53	2 ,, ,, 8	—	—	—

After feeding the insects for twenty-one days on the respective diets, it was of interest to determine the recuperative power of these larvæ when they were transferred to diets containing the growth-promoting factors. On the twenty-first day of experiment, respective batches of larvæ were transferred to diets as indicated in Table I, and the insects weighed after known intervals of time.

It will be observed from Table I that (1) the sample of refined groundnut oil contains growth-promoting factors which are removed by successively chromatographing the oils through columns of alumina; this method of separation does not introduce any fundamental change in the chemical composition of the glyceride. (2) It has been further shown that the growth-promoting factors may be recovered from the chromatographed columns, in a potent condition, a fact which may prove extremely valuable to those interested in the preparation and purification of biologically active sterols. (3) The larvæ struggling on a sterol-free diet retain their recuperative power for comparatively long periods; they respond quickly and vigorously to additions of the elutate to their diet.

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VITAMINS, MINERALS, CARBOHYDRATES AND PROTEINS IN TUBERS—I

TUBERS form an important part of diet of the poorer class of people of this Province in particular. Considering their abundance, availability and storing capacity, it was thought desirable to determine their nutritional value by carrying out their chemical analyses. In the work presented here, analyses of tubers commonly available at Bombay were undertaken for vitamins B_1 and C, Minerals—phosphorus, calcium and iron, Carbohydrates—sugars, starch, etc., and proteins.

Vitamin B_1 was estimated from the water extract employing H. Tauber's method slightly modified in this laboratory. The estimation of vitamin C was carried out in trichloracetic

Results of 100 gm. of Edible Portion of Tuber

Common name	Botanical name	Moisture	Vitamin B_1 in Int. Units	Vitamin C in mgm.	P gm.	Ca gm.	Fe in mgm.	Protein gm.	Reducing Sugar gm.	Non-reducing Sugar gm.	Starch gm.	Cellulose and other undetermined constituents gm.
Colocasia	*Colocasia antiquorum* (Allahabad variety) ..	92·180	66·450	1·405	·060	·022	1·518	2·179	0·034	0·086	3·758	1·680
Elephant's foot	*Amorphophallus campanulatus* (Surat variety) ..	71·010	24·290	1·721	·031	·057	0·981	1·770	3·752	4·281	6·438	12·660
Potato	*Solanum tuberosum* (Talegaon variety)	78·400	22·250	13·660	·038	·081	0·672	1·530	0·000	0·340	18·003	1·607
Sweet Potato	*Ipomœa batatas* (Konkan variety) ..	71·298	18·940	17·403	·061	·024	0·773	1·105	0·430	0·480	22·100	4·501
Radish	*Raphanus sativus* (Large white variety)	94·630	71·770	16·780	·025	·045	0·359	0·537	1·717	1·230	0·188	1·628
Knol-kol	*Brassica oleracea* Caulorapa ..	90·170	83·210	23·346	·026	·030	0·498	2·825	1·892	1·430	0·522	3·105
Turnip	*Brassica campestris* (var.) *rapa*. White napiform variety .	92·396	80·700	11·520	·037	·077	0·350	1·646	1·868	0·900	0·432	2·644
Beet Root	*Beta vulgaris* ..	86·570	76·408	26·210	·051	·182	0·953	1·806	1·020	7·852	0·246	2·272
Carrot	*Daucus cariota* (Orange conical variety) ..	81·150	64·913	2·389	·036	·082	1·320	0·948	6·757	4·231	0·113	6·682

acid extract, using the method adopted by L. J. Harris and S. N. Ray.[1] The ash of tubers was analysed for phosphorus, calcium, and iron using the methods developed by Brigg,[2] McCrudden,[3] and Kennedy[4] respectively. Carbohydrates were estimated, as in fruits, by N. D. Rege and S. C. Devadatta.[5] Subtracting the total amount of various constituents estimated from the dry weight, the amount of cellulose and other unestimated constituents present was calculated. Kjeldahl's method was adopted for the estimation of protein nitrogen. Full paper will be published elsewhere. The results recorded in the table indicate the mean of six careful estimations.

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S. C. Devadatta.

Wilson College,
Bombay,
September 15, 1942.

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1 Harris & Ray, *Biochem. J.*, 1933, **27**, 303.
2 Brigg, *J. Biol. Chem.*, 1922, **53**, 13.
3 McCrudden, *Ibid.*, 1909, **7**, 83; 1911, **10**, 187.
4 Kennedy, *Ibid.*, 1927, **74**, 385.
5 Rege & Devadatta, *J. Univ. Bom.*, 1941, **10**, 3B, 74.

THE FATTY OIL FROM THE SEEDS OF *MALLOTUS PHILIPPINENSIS*, MUEL

The above oil has been prepared in this laboratory recently by extraction of the seeds collected locally with petroleum ether (B.P. = 40-60° C.) and the analytical data reported elsewhere.[1] When benzene is used for extraction, it extracts in addition to the oil, about 11 per cent. of a petroleum-ether insoluble resin. In a thin film, the oil dries in two

Constants	Author[1]	Singh and Saran[2]
Per cent. kernels in seeds	47	..
Per cent. oil in kernels	61 (Benzene)	48·8 (Benzene)
	50 (Petroleum ether)	..
Sp. Gr. of oil	0·8860/30° C. (Petroleum ether)	0·9333/33°C. (Benzene)
Refractive Index	1·4979/30° C.	1·5156/34°C.
Acid Value	19·0	11·3
Saponification Value	170·3	207·6
Iodine Value	183·2 (Hanus)	157·3
Acetyl Value	49·2	46·8
Unsaponifiable matter	1·8	1·9

hours and if left in a stoppered bottle for a few days, gets converted like tung oil into a

hard rubber-like mass. In view of a recent note[2] on the same oil by Singh and Saran, I give in the above table our several data for comparison and further study.

It is possible that the above differences in our data are due to the saponifiable resins that benzene extracts from the seeds.

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Dehra Dun,
September 6, 1942.

[1] *Forest Research in India*, Part I, 1940-41 and 1941-42.
[2] *Curr. Sci.*, 1942, **11**, 360.

THE NATURE AND FERTILISING VALUE OF PHOSPHORUS IN SEWAGE

ALTHOUGH the high phosphorus content of sewage is generally known, its fertilising value is ascribed only to its nitrogen and organic matter contents. The investigations of the author have shown that the phosphorus of sewage is not only largely available but also an important factor determining crop yield from certain types of soils. Thus, in a soil deficient in phosphoric acid [total P_2O_5, 0·037 per cent. and available P_2O_5 (Truog's method) 14 p.p.m.] application of sewage gave better response than an equivalent dosage of nitrogen in the form of ammonium sulphate, compost or seed cake. Application of phosphorus to this soil increased the yield as well as phosphorus content of the herbage. The following results will illustrate the above:

TABLE I

Nitrogen and phosphorus contents of sewage and activated sludge

	(Parts per 100,000)		
	Total N	N as nitrate	Total P_2O_5
Raw sewage	5·5	0·11	4·09
Wet activated sludge (with effluent)	18·4	0·72	12·70
Effluent	1·85	0·95	0·40

TABLE II

Response of tomato to different treatments

Treatments	Yield in gm. per pot
Tap water irrigation	131·7
Ammonium sulphate with tap water irrigation	174·5
Compost with tap water irrigation ..	227·6
Raw sewage irrigation	658·0
Raw sewage irrigation alternating with tap water	573·1
Effluent irrigation	315·6
Wet activated sludge irrigation ..	768·4

TABLE III

Response of Ragi (Eleusine coracana) *to different treatments*

Treatments	Initial Ht. in cm.	Growth in gm. 45 days	Dry matter in gm.	% P_2O_5 in dry matter
Tap water irrigation series				
Control (no manure) ..	17·8	20·9	0·9	0·25
75 gm. cake per pot ..	16·7	31·9	1·5	0·27
20 gm. super phos. ..	17·2	41·9	4·3	0·50
75 gm. cake + 20 gm. super phos. ..	17·7	67·5	25·6	1·24
60 gm. super phos. ..	16·4	51·3	5·9	1·10
Raw sewage irrigation series				
Raw sewage irrigation ..	16·3	54·3	9·6	0·32
75 gm. cake ..	24·3	62·3	21·6	0·37
60 gm. super phos. ..	15·8	75·2	23·4	1·62

Soils under sewage irrigation for over 20 years show accumulation of phosphoric acid in the surfaces 6″ and to some extent in lower depths (Tables IV and V) and quite a large proportion of this is in available form.

TABLE IV

Percentages of total and available P_2O_5 in Bangalore sewage farm soils

Depths	Under sewage irrigation		Not under sewage	
	Total P_2O_5	Available P_2O_5	Total P_2O_5	Available P_2O_5
0″ – 3″	0·130	0·062	0·083	0·025
3″ – 6″	0·220	0·087		
6″ – 9″	0·070	0·018	0·056	0·009
9″ – 21″	0·017	0·0005	0·017	0·0005

TABLE V

Per cent. total and available P_2O_5 in Nagpur sewage farm soils

Depths	Under sewage irrigation		Not under sewage	
	Total P_2O_5	Available P_2O_5	Total P_2O_5	Available P_2O_5
0″ — 3″	0·226	0·100	0·065	0·023
3″ — 6″	0·146	0·065	0·063	0·024
6″ — 12″	0·079	0·025	0·049	0·015
12″ — 24″	0·059	0·018	0·038	0·010

From the fractionation of phosphorus of raw sewage and dried activated sludge given in Table VI, it will be seen that sewage contains a large proportion of water-soluble phosphorus and that the major portion of the total phosphorus is in inorganic form.

TABLE VI

Fractionation of phosphorus of sewage and sludge

Fractions	Raw sewage parts per 100,000	Dried sludge % of dry material
Total P_2O_5	1·75	2·16
Water-soluble P_2O_5	0·66	0·46
N/500 H_2SO_4 extractable P_2O_5	0·44*	0·24*
N/100 H_2SO_4 extractable P_2O_5	0·54*	0·54*
N–HCl extractable inorganic P_2O_5	0·94*	0·89*
N–HCl extractable organic P_2O_5	0·10	0·30
1% NaOH extractable organic P_2O_5	—	0·09
P_2O_5 in α–humus	—	0·10
α–humus	—	15·10

* excluding water soluble P_2O_5.

The enrichment of the surface layers of the sewage irrigated land is partly due to fixation of the water-soluble phosphorus and partly due to the addition of insoluble inorganic and organic phosphorus. After years of irrigation, it has been observed that soils under sewage irrigation show presence of water-soluble phosphates to a depth of 12″ or even more. But the surface 6″ layer soil contains a fairly large amount (1·5 to 7 p.p.m. in 1:5 water extract) and is fully saturated, as the soil cannot render any more water-soluble phosphates into insoluble forms. It is under these conditions that the water-soluble phosphate in sewage will penetrate to lower depths.

The details relating to the above and other relevant observations will be published elsewhere.

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October 5, 1942.

PSILOTUM TRIQUETRUM SW. AT LONAVALA, BOMBAY PRESIDENCY

Psilotum triquetrum Sw. is one of the two species[1] of the genus widely distributed in the Malayan peninsula. This species is known to occur in many parts of India also but its distribution[2] seems to be discontinuous as the plants are often both local and rare. In the Bombay Presidency the species had been reported to occur at Sawantwadi by Dalgado[3] in 1896, and in the vicinity of Castle Rock and Karanzol (North Kanara) by one of us[4] in 1938.

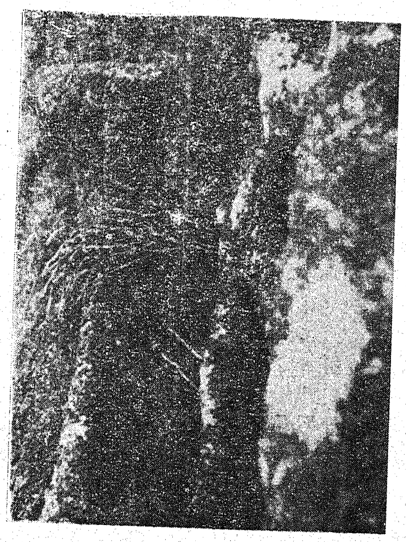

FIG. 1

Psilotum triquetrum Sw. growing in the masses of aerial roots of *Ficus retusa*.

Last November, on a collecting trip to Lonavala a few plants of the same species

were observed to grow in the masses of aerial roots entwining the tree trunks of *Ficus retusa* growing at a distance of about half a mile from Lonavala on the way to Khandala by the old Khandala road, epiphytically, in contrast to their usual terrestrial habit noticeable at Castle Rock and Pachmari.[5] This constitutes a third record of the occurrence of this rare plant in the Bombay Presidency, and it extends the northerly limit of distribution of this species in the peninsular India considerably.

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Ahmedabad,
November 16, 1942.

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[1] The other species *P. complanatum* Sw. (incl. *P. flaccidum* Wall.) is not known to occur in India.

[2] For an account of the distribution of this species in India see Raizada, M. B., *Indian Forester*, 1935, **61**, 654–58.

[3] Dalgado, D. G., *Journ. Bom. Nat. Hist. Soc.*, 1896, **7**, 544.

[4] Mahabalé, T. S., *Journ. Bom. Univ.*, 1938, **6**, 62–75.

[5] In the forests in Shimoga District (Mysore State), however, the species is known to be both terrestrial and epiphytic in habit.

SEX DIMORPHISM IN *THYROGLUTUS MALAYUS*

Thyroglutus malayus is the largest millipede which occurs in and around Lucknow. The specimens vary from dusky red to light vermillion in colour. They are essentially terrestrial animals living in moist places concealed beneath stones or bark of decaying timber or amongst rich humus soil and feeding on decaying vegetable matter. *Thyroglutus* has an elongated cylindrical body—the length varies from about 3·00 cm. to 4·5 cm. The body is divided into a large number of segments varying between 58 to 63. The body of the millipede is divisible into three main parts, *viz.*, head, thorax and abdomen. The thorax lies immediately behind the head and is composed of four segments. Each segment is a complete ring of hard and brittle chitin. The thorax is distinguished from the abdomen by the fact that the first three segments of the thorax bear a single pair of legs and that the fourth thoracic segment is apodal. The second segment bears the generative openings besides the single pair of legs. In the thorax there is no trace of diplopody, a feature so characteristic of the abdominal region as to give the name "Diplopoda" to the whole group of millipedes.

In the case of millipedes the males can usually be distinguished from the females by the differences in size, *e.g.*, in *Strongylosoma contortipes* (which is very common in Lucknow) the males are thinner and smaller in size than the females upon which they are usually seen *riding* during the breeding period. The females are much stouter and carry the males on their back over long distances. Similarly in another local millipede *Orthomorpha modestina* there are clear differences in size between the males and the females. In the case of *Thyroglutus malayus*, however, the sizes of the males and the females vary considerably and the males may be sometimes larger than the females. But even in these cases the sex can be easily ascertained by certain external characters. Four such main characters may be mentioned, *viz.*, the nature of *Collum*, the condition of the post-thoracic segments and the variation in the second and seventh segments.

The first thoracic segment, which is broad and situated next to the head is known as the *Collum*. It is an incomplete ring as it is only the dorsal arch or scutum of a normal segment. A pair of legs is attached to the soft ventral portion of this segment. The shape and size of the *Collum* differs in the males and the females. In the females the *Collum* is comparatively larger than in the males. The lateral angle of the tergum of *Collum* is directed forwards in the males but is directed backwards in the females. The lateral sides of the *Collum* are more or less apical in the females while they are broad in the males.

The next three thoracic segments are normal both in the males and the females. But in the latter there is a narrowing of the circumference of the first three post-thoracic or

abdominal segments and then gradually the segments broaden again till the sixth abdominal segment is normal in circumference. Thus a narrow region, the so-called "Neck", is exhibited. In the males on the other hand there is no "Neck" as there is no narrowing of the segments in the body. The presence or absence of the "Neck" serves as a convenient distinguishing feature between the females and the males.

The second thoracic segment is smaller than the first but is complete and bears a single pair of legs behind which lies the generative opening. In the females the sterna are incompletely fused posteriorly and give rise to paired openings situated in between the second and third sterna and lying immediately behind the second pair of legs. These openings are placed on the paired oviducal projections. In the males the generative opening is single and median. It is a slit-like opening borne on an oval chitinous plate in the mid-ventral region of the second sternum.

The seventh body segment or the third abdominal segment is normal in the females, *i.e.*, it bears the two pairs of legs; but in the males it shows certain modifications. The double pair of legs are entirely absent and instead there is present a single pair of modified gonopods. These gonopods which emerge from the sternal opening do not bear the male reproductive aperture but help in the process of copulation by keeping the oviducal apertures open.

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Lucknow University,
October 24, 1942.

A NOTE ON THE PRAWN FAUNA OF TRAVANCORE

PANIKKAR (1937)[1] in an article entitled the 'Prawn Industry of the Malabar Coast', recorded seven common species of Penæid and five species of Palæmonid prawns from Travancore, and suggested that "it is probable that numerous other species recorded from other parts of India are also present here". This statement has been borne out by a recent survey of the Prawn Fauna of Travancore, conducted by me at the suggestion of Dr. C. C. John. The survey has not only brought to light many species unrecorded from this area, but has also proved that a few of the species regarded as 'common species' by Panikkar are either very rare or totally absent. Panikkar regards *M. lysianassa* as a common species, whereas I have not come across even a single specimen of this species in Travancore waters during the three years of my investigation. Further I have not been able to collect *P. scabriculus* recorded by Panikkar.

With Burkenroad's (1934)[2] revision of the genera *Penœopsis* and *Metapenœus*, Panikkar's *Penœopsis* becomes *Metapenœus*. *M. dobsoni*

Family	Genus	Species
Penæidæ ..	Penæus	* *P. indicus* M. Edw. * *P. carinatus* Dana (de Man). * *P. monodon* Fabr. Alcock. † *P. canaliculatus* Oliv.
	Metapenæus	* *M. monoceros* (Fabr.) * *M. affinis* (M. Edw.) † *M. dobsoni* var. nov.
	Penæopsis (sub g) Metapenæopsis	† *M. stridulans* Wood-Mason † *M. mogiensis* Rathbun
	Parapenæopsis	* *P. stylifera* (M. Edw.) † *P. maxillipedo* Alcock. † *P. uncta* Alcock.
Palæmonidæ	Palæmon	* *P. carcinus* Fabr. * *P. idæ* Heller. *P. dolychodactylus* Hilgendrof *P. sulcatus* Henderson and Matthai. † *P. dayanus* Henderson
	Palæmonetes	† *P. hornelli* Kemp.
Alpheidæ ..	Alpheus	† *A. malabaricus* Fabr. † *A. paludicola* Kemp.
Sergestidæ ..	Acetes	† *A. erythræus* Nobili. † *A. sibogæ* Hansen. † *A. dispar* Hansen. † *A. serrulatus* var. now.

* Common species.
† Recorded for the first time from Travancore.

described from Travancore, appears to be a new variety having a wide distribution both in the sea as well as in the lakes.

A list of prawns recorded from Travancore is given below:—

I wish to express my grateful thanks to Dr. C. C. John for all the help and guidance rendered during the investigation.

S. NATARAJ.

Marine Biological Laboratory,
University of Travancore,
Trivandrum,
November 27, 1942.

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[1] *Journ. Bombay Nat. Hist. Soc.*, **39**, No. 2.
[2] *Bull. Bingham Oceanographic Coll.*, **4**, 7, 7.

PRELIMINARY OBSERVATIONS ON MYXOSPORIDIA FROM SHARKS

THE meagreness of our knowledge of myxosporidia is surprising despite the widespread occurrence of this group both in marine and fresh-water fishes. Myxosporidia, as is well known, are found mostly in the gall bladder of fishes, but they have also been observed in other organs, such as, testis, ovaries, urinary bladder, brain, etc. Very few species of Myxosporidia have been recorded in India and for such knowledge as we have of this group we are indebted mainly to the studies of Southwell (1915), Southwell and Prashad (1918 and 1933), Ray (1933), Ganapati (1936) and Chakravarty (1939 and 1941). Most of the species described by these workers are of fresh-water fish from Bengal. These workers have not, however, investigated the occurrence of the parasites in particular groups of fishes but described them as they have found them in certain fishes. In this respect their work differs from that of Kudo, in Japan, who investigated numerous species of both marine and fresh-water fishes; or from that of Davis in Florida, who worked on representative groups of both marine and fresh-water fishes of the Beaufort region in North Carolina (U.S.A.). Both Kudo and Davis investigated the ocurrence of the parasite in whole groups of fishes, and their investigations have thus added considerably to the literature on the subject.

The need for similar study of myxosporidia infection among our fishes has long been overdue and the present investigation, conducted by Miss S. D. Mistry, B.Sc., which is confined to the Elasmobranchs (sharks, skates and rays) only, has accordingly been undertaken. In this preliminary conspectus of the work done, I desire to place on record a list of hosts examined and the parasites found in them for the first time in this country. The list does not, however, include a number of hosts which appeared to be free from infection. A special feature worthy of mention is that invariably more than one species of the parasite has been found infecting the same organ. Thus, the gall bladder of *Cestracion zygœna* was found to contain a large number of trophozoites and spores of three species of myxosporidia, while *Caracharinus limbatus* contained no fewer than five species. Another striking fact disclosed during the investigation seems to be that Elasmobranchs are infected exclusively by three genera of myxosporidia. The genera, in the order of frequency in which they are encountered, are Ceratomyxa, Chloromyxum and Leptotheca. The absence of any other genus of myxosporidia in this group is indeed remarkable in view of the fact that they feed on a large variety of marine fishes, which, in their turn, are infected by other genera of myxosporidia. The three genera referred to above seem to be specially characteristic of Elasmobranchs not only in India but also elsewhere in the world and seem to be most suited for life in them.

Kudo, in his "Studies on the Myxosporidia", published in 1919, includes all forms reported in the world till then. He has listed 223 fishes as hosts, of which 24 belong to the Elasmobranchs, including the genus Raja, which, however, is not represented in Bombay waters. Kudo's observations, also, support the view that the Elasmobranchs are specially infected by the three genera of parasites enumerated above. Kudo, however, adds a fourth genus,

namely, Myxidium, found in representatives of the family Rajidæ.

Several species representing the three genera are new, and a detailed description of these will soon be published.

Host	Number of species from each host	Genus	Seat of Infection
1. *Carcharinus pleurotænia*	1	Ceratomyxa	Gall bladder
2. *Cestracion blochii*	2	Ceratomyxa Chloromyxum	do
3. *Cestracion zygæna*	3	Ceratomyxa Ceratomyxa Chloromyxum	do
4. *Chiloscyllium griseum*	1	Chloromyxum	do
5. *Carcharinus menisorrah*	2	Ceratomyxa Ceratomyxa	do
6. *Carcharinus limbatus*	5	Leptotheca Chloromyxum Ceratomyxa Ceratomyxa Ceratomyxa	do
7. *Hemigaleus balfouri*	3	Ceratomyxa Ceratomyxa Chloromyxum	do
8. *Pristis cuspidatus*	2	Chloromyxum Ceratomyxa	do
9. *Rhynchobatus djeddensis*	2	Chloromyxum Ceratomyxa	do
10. *Scoliodon sorrakowah*	3	Chloromyxum Ceratomyxa Leptotheca	do
11. *Scoliodon* sp.	2	Chloromyxum Ceratomyxa	Kidney Gall bladder
12. *Scoliodon walbeehmi*	3	Ceratomyxa Ceratomyxa Chloromyxum	do
13. *Scoliodon palasorrah*	2	Ceratomyxa Chloromyxum	do
14. *Carcharinus bleekeri*	3	Ceratomyxa Ceratomyxa Chloromyxum	do
15. *Hypoprion macloti*	2	Ceratomyxa Ceratomyxa	do
16. *Carcharinus melanopterus*	2	Ceratomyxa Chloromyxum	do
17. *Trygon bleekeri*	1	Chloromyxum	do
18. *Rhynoptera javanica*	1	Chloromyxum	do

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November 23, 1942.

THE EFFECT OF DAMS ON THE MIGRATION OF THE HILSA FISH IN INDIAN WATERS

IN the October issue of *Current Science*,[1] Devanesen has done a great service by directing attention to the fact that the construction of weirs in the Godavari, the Kistna and the Cauvery rivers has reduced the spawning areas of the Hilsa fish with disastrous results to its fisheries in South India. His presumption that before the erection of dams "the spawning Hilsa had the whole run of the river excepting the upper reaches" is abundantly borne out by the fact that in the Ganges the young of Hilsa have been collected as high up as Allahabad[2] and the fish is known to ascend as far as Agra and Delhi. The reported destruction of Hilsa in roe in immense numbers below the first anicut by fishermen is to be greatly deprecated and certainly calls for some protective, legislative measures.

After discussing the futility of the existing fish-passes and the establishment of hatcheries for the resuscitation of the depleted rivers, Devanesen suggests that "prohibiting fishing within a five-mile (?) length of the river from the first weir, observing a closed season of a few weeks or restricting fishing below the first weir to three days in a week may produce a salutary effect on the Hilsa-fisheries". There can hardly be any two opinions regarding the utility of these measures and the beneficial effects they are likely to have in adding to the stock of the existing population of Hilsa in the Indian waters.

The readers of *Current Science* will recall that a short time ago[3] the present writer in reviewing a symposium held in America, on 'Dams and the problems of migratory fishes', *inter alia* directed attention to similar problems in India. This subject was thoroughly discussed by the Fish Committee of the Imperial Council of Agricultural Research in October 1941, and on its recommendations the Governing Body of the Council requested "all provinces and State Governments to give due consideration to the fishery resources of the

water-ways, and that before starting construction of a dam or other types of structure proposed in any basin containing migratory fishes, surveys of fishery resources should be carried out by an expert with a view to making proposals to safeguard the interest of the majority of economically important fishes of the area. It was further recommended that as fish-ladders in some provinces had proved to be unsatisfactory, they should be replaced by more suitable devices to safeguard fish populations. Similar measures should also be introduced in other provinces where they did not already exist. It was also suggested that fishing should be prohibited within one mile of the lower reaches of a dam."

The Imperial Council of Agricultural Research has thus given a valuable lead and it is up to the various Governments to institute surveys of fishery resources by experts and if the existing fish-passes or fish-ladders are unsatisfactory they should replace them by more suitable structures. The prohibition of fishing within one mile of the lower reaches of a dam was just a suggestion, but in case it is found necessary to prohibit it over a greater area provision should be made for that in any protective measures that may be adopted.

Devanesen has shown that in view of the inability of Hilsa to leap in the air and of its habit of spawning in the lower and middle reaches of the rivers there is no case for fish-passes to be built for the migration of this fish. However, no experiments have yet been conducted on the type of suitable dams for different migratory fishes of India and in this connection it may be noted that in England, Wales and Scotland "the difficulties presented as regards the ascent of the breeding fish and the subsequent descent of the fry and kelts have now to some extent been met by the idea of a fish-pass with an adjustable feed from the reservoir, as has been adopted at Tongland (where the range of fluctuation in the top-water level does not exceed 41 ft.) and at the other impounding reservoirs on the same river system (the Kirkcubright Dee) which are comprised in the Galloway Power Scheme".[4]

There is no reason why experts in this country through extensive experimental studies should not be in a position to devise suitable measures to safeguard the interest of the majority of economically important fishes of the area likely to be effected by the construction of a dam.

Devanesen has also hinted on the futility of Hilsa hatcheries for the resuscitation of the South Indian rivers and his views are based on a long experience of experimental work conducted by the Madras Fisheries Department. For quite different reasons, I came to the conclusion that Hilsa hatcheries are not required for Bengal waters and I hope until the circumstances change no further costly experiments will be conducted in establishing hatcheries for this fish.

S. L. HORA.

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Ballygunge, Calcutta,
November 20, 1942.

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1 Devanesen, D. W., "Weirs in South India and their effect on the bionomics of the Hilsa in the South Indian rivers—The Godavari, the Kistna and the Cauvery," *Curr. Sci.*, 1942, **11**, 10, 398.

2 Hora, S. L., "Dams and the problem of migratory fishes," *Curr. Sci.*, 1940, **9**, 9, 406, 407.

3 —, "Life-history and wanderings of *Hilsa* in Bengal waters," *Journ. Roy. As. Soc. Bengal*, Science, 1940, **6**, 93-112.

4 Anon, "Dams and the problem of migratory fishes," *Nature*, 1941, **147**, 487.

[See bibliography for earlier literature on the bionomics and fishery of the Hilsa fish.]

REVIEWS

Cathode Ray Tube and Its Applications (Second Edition). By G. Parr. (Chapman & Hall, London), 1941. Pp. viii + 180. Price 13*sh.* 6*d.*

Besides the thermionic valve, if one were to name an electrical apparatus of the greatest use alike for instructions, for research, or in industry, it would, undoubtedly be the Cathode Ray Tube. The above publication is a concise but very comprehensive and up-to-date treatment of this important and fast developing subject and would be useful both to the layman and to the expert. The contents have been classified in a rational and progressive manner and all the essential features in theory and practice, have been dealt with briefly without undue complication by higher mathematics. The chapters on 'Industrial and other Applications' and 'Television' are particularly interesting. A very recent application of the tube, however, as a coronavisor, which produces a picture of the solar prominences and corona for study at any time without the necessity for the occurrence of a solar eclipse, appears to have just missed the publication of the book. One of the most useful features of the book is the bibliography of 737 articles at the end, which forms an excellent compilation of references upto 1941. It would be of immense assistance to persons desiring to pursue further specific aspects of this apparatus. The printing and get-up of the book are entirely satisfactory in spite of its being a war-time publication.

Handbook of Physical Constants and Mathematical Tables. By T. N. Seshadri. (S. Viswanathan, 2|10, Post Office Street, Madras), 1942. Pp. 48. Price As. 12.

This handbook, or shall we say, pocket-book, is very similar to the well-known publications by J. M. Clark, both in format and the clear printing and get-up. It covers all the usual reference data and tables required for calculations in routine laboratory work. The book is free from printers' errors. Two textual errors, however, occur in page 8 and should be immediately corrected, *viz.*, 1 gallon of water weighs 10 lbs. *not* "apxly" but at 62° F. and 30" Hg. Also 1 Kilo-watt hour is *not* 1 B.T.U. of energy but 3413 B.T.U. of energy.

The book is priced rather high at 12 annas, but we hope that this is only a war-time price. It is an Indian publication deserving of full encouragement.

Plastics in Industry. (Second Edition). Revised by "Plastes". (Chapman and Hall, London), 1942. Pp. xiii + 248. Price 15*sh.*

This is a compendium on plastics with special reference to their present and potential uses in industry; the contents have a special appeal to the progressive industrialist who is on the look out for new materials of construction. The domain of plastics is rich in variety, quality and colour and the rapid advances made in the field have rendered it possible to find a plastic for almost every kind of manufacturing job. Diverse objects such as radio cabinets, milk bottles, bearings for metal rolling-mills, aeroplane parts, electrical accessories, furniture and fancy goods and coffins, have all been made from various types of plastics.

The ever-increasing scarcity of certain classes of metals created by the exigencies of war, has stimulated the necessity to find alternative sources of constructional materials; in this regard, plastics offer one of the most fruitful fields for exploitation. In a series of eighteen chapters, the author has clearly and successfully presented a picture of the nature, characteristics, types, specifications, moulding and fabrication techniques and applications of the several important varieties of plastics. The illustrations are beautiful and instructive; they enhance the value of the volume. It is a general treatise on plastics, which should interest not only the industrialist but also the general reader who may be interested in obtaining an idea of the nature and uses of plastics, the products of which are so familiar a feature of every office and household.

Practical Physics for Intermediate Students. By V. Venkata Rao, D. A. A. S. Narayana Rao and T. S. Narasimhamurthy. (The Authors, Vizianagram), 1942. Pp. 218. Price Rs. 2-4-0.

Many a student is more concerned with his practical record than with his experiments and tries to commit it to memory so that he may get through his practical examination. Books which are merely substitutes for practical records only abet this tendency and leave no scope for the student to dev-

elop the creative faculty in him. This defect is to be drastically remedied. It is, therefore, to be seriously considered whether it is desirable at all that a student should, for improving his scientific abilities, take help from such books.

The volume under review has a limited objective in view, *viz.*, to take the students of the Andhra University I.Sc. safely through the practical examination. The authors have spared no pains to meet these requirements. However, a little more care should have been bestowed on the diagrams in some of which the clamps and the corks are out of all proportion to the rest of the apparatus. In some places the word 'weight' has been used for the word 'mass'. The reviewer hopes that these will be taken into consideration by the authors, in any revised editions.

D. S. S.

Spectroscopy and Combustion Theory. By A. G. Gaydon (with a Foreword by Prof. A. C. Egerton). (Chapman and Hall, London), 1942. Pp. x + 191. Price 17*sh.* 6*d.*

The book deals with the contributions of spectroscopy to the theory of combustion. That it should appear in the midst of a devastating war is rather significant. Aerial bombardment as a weapon to exterminate cities has not been completely successful. Better knowledge of the mechanism of combustion will, of course, enable man to improve upon this weapon in future wars! It will also lead to more economical methods of utilizing fuel materials, the world supply of which may not be long maintained. Lastly, there is the potential gain of extension of knowledge and the satisfaction of having 'wrested' some more of Nature's secrets, consequences of which are not easy to foresee.

The spectroscopic approach to many problems is still in its beginnings. It is especially so in the case of problems of combustion because the processes here concerned involve radicals and molecules more than atoms; and molecular spectroscopy itself, is of comparatively recent growth. The book under review is an attempt "to collect together and discuss the results of recent research in the various ways in which spectroscopy has been applied to combustion problems". Naturally, in a subject like this which is still in the making, many conclusions are bound to be provisional and a certain amount of personal bias cannot be eliminated. In spite of these limitations, the author has certainly brought to bear upon the subject a broad, refreshing and stimulating outlook. The publication is a welcome addition to the not very extensive literature (specially in English) on molecular spectroscopy. The book, along with a modest spectroscopic laboratory, is what the reviewer would highly recommend to the various institutions which are interested in fuel technology in this country.

R. K. ASUNDI.

You and Your Radio. By Vepa V. Lakshmana Rao, B.E., D.I.C., A.M.I.R.E. (Madras Law Journal Press, Mylapore, Madras), 1942. Pp. xvii + 187. Price Rs. 3.

The "Radio Receiver" is now a definite item in the accoutrement of many Indian houses. It is widely used merely as a clever tool devised by the scientists for tapping messages passing through the "air" and emanating from various "Stations" and when it gets out of order, it has only to be packed up and sent to the nearest "repair shop" for reconditioning. But the human species is by nature curious and there are many who are eager to know, without going much into the details, something of the "innards" of their set and of how it works and how the messages are put over into the air from the various stations. The average school or college student can at best tell him something of the "lamps" used inside and a few other generalities but this is rarely satisfying. Mr. Vepa has now come forward to fill this need and he presents in a breezy conversational style an explanation of the whole organisation of "broadcasting" and of the several mysterious technical terms such as "fading", "skipping distance", etc., which are so commonly used by the technicians. The book covers a very wide range of topics, including interference suppression, what and when to tune?, radio-gramophone, batteries and their upkeep, radio relaying, types of radio licenses, rural broadcasting, etc.

It is therefore, the more to be regretted that such a book should be marred by the extreme crudity of some of the illustrating diagrams. We refer in particular, to those on pages 37, 85, 89, 118 and 129. It is hoped that by the time a next edition is called for the author will get ready a complete new set of carefully drawn diagrams to replace the present ones. With this improvement one can anticipate that the book will get increasingly popular.

G.

NEWTON, MATHEMATICS AND RAMANUJAN

BY

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(*Librarian, Madras University Library, and Secretary, Madras Library Association*)

SEPARATED by an interval of about two centuries and a half, the mathematical heritage of mankind was enriched by two remarkable men—Newton born in Britain, 25 December 1642, and Ramanujan born in India, 22 December 1887. They had just a little in common; but they differed widely in most matters—even in the force that pulled them to mathematics.

1. Dissimilarities

Newton spent his early years in fairly comfortable circumstances, in spite of his father dying before his birth and his mother remarrying before he was three; Ramanujan's parents, though both were living, could not keep him above want till he began to earn. Before entering adulthood, Newton had passed through the University of Cambridge, learned virtually all that could then be learnt in mathematics and contacted the eminent mathematicians and natural philosophers of his days, either as teachers or as friends; but till his twenty-fifth year Ramanujan could not come across any who would understand him or his language and still less teach him, nor could he finish the university course nor know the then state of mathematical knowledge. Notwithstanding his anxiety to avoid 'contention' of any kind, Newton's discoveries involved him in frequent and bitter controversies and much tension prevailed between him and his peers; it was, on the other hand, an atmosphere of uniform and spontaneous admiration, love and respect that surrounded Ramanujan after he was discovered. Newton was long-lived; Ramanujan died prematurely.

2. Similarities

And yet they had just a few things in common. Mathematics was the meeting ground of the two geniuses, though they approached it from different directions. Their life's work was done by the time they were thirty, though one lived for half a century thereafter and the other gave up his mortal coil almost immediately. Newton wrote down his results in diaries, letters and note-books, most of which are still preserved in some British libraries and had been all published in his own days though it was a job to make him release them for print; Ramanujan too wrote down his results systematically in a note-book which he left behind in England, where I was fortunate to pick it up in 1925 though it was in a tattered state; and it is now the most precious possession of the Madras University Library, still awaiting publication as a whole. The Royal Society elected both of them as its fellows before they passed thirty.

3. Integral Calculus

Newton's boyhood had been rich in hobbies of a mechanical sort like making kites, sundials and windmills. Kepler's *Optikas* is said to have been the first book to engage his serious thought. Consistently with this, one of the important books that Newton himself published was his *Opticks* (1704). He would grind lenses and if the telescope could not be made achromatic, he would invent a new type of telescope, the reflecting one. Consistently with this if a mathematical tool was wanting or defective, he would improvise a new tool or sharpen what existed. When his theory of gravitation led him to calculate the attraction of a sphere, which he could not do by the then known mathematical tools, he invented a new tool—the integral calculus. Particular problems of finding lengths, areas and volumes had been solved before him by special devices; but a general tool applicable to all similar problems was invented only by Newton and that because his preoccupations with his theory of gravitation needed it. The *Tractatus di quadratura curvarum* first appeared as an appendix to his *Opticks*.

4. Conics

The determination of a central orbit as a conic involved Newton in facing the problem of finding the conic when a focus and three other conditions or any other five conditions were given. These were fully investigated in the *Principia* (1687).

5. Problem of Three Bodies

The phenomenon of tides challenged Newton for an explanation on the basis of his theory of gravitation. While Proposition 66 of Book I and 24 and 26 of Book III of the *Principia* were turned on it directly, the foundations of the profound problem of three bodies were also laid incidentally.

Calculus of Variations

In considering the form of ships, Newton was obliged to determine the shape of bodies of revolution that will experience the least resistance when moved in the line of its axis. He improvised in 1686 a new tool to do this job and showed it to Fatio Duillier who published it in the pamphlet *Investigatie geometrica solidi rotundi in quod minima fiat resistantin* (1699). This tool, the calculus of variations, was lost sight of, until it was rediscovered by Lagrange in 1762.

Calculus of Finite Differences

Proposition 40 of Book III of the *Principia* is followed by Lemma 5 which gives a general solution of the problem: "To describe a geometrical curve which shall pass through any given points"—the fundamental proposition of the calculus of finite differences. *Methodus differentiates* (1711) which gives another solution of the same problem was first translated into English in the pages of the *Journal* of the Institute of Actuaries in 1918.

Cubics

The *Enumeratio linearum tertu ordinis* which appeared as an appendix to *Opticks* was the first systematic contribution to the theory of higher plane curves. 72 species of cubics were enumerated. As many propositions were without proof, this became one of the most commented of Newton's works. His method of classifying cubics appears to have inspired Waring to apply it to the quartic of which he obtained 84,551 species. To evaluate Newton's contribution to this field, we should remember that the modern tool of projective geometry had not yet been forged.

Calculus of Fluxions

The most discussed of Newton's tools from the point of view of priority of discovery is the calculus of fluxions. This again was forged to meet a definite situation in the determination of orbits. In fact he first invented the binomial theorem and then this calculus. The *Principia* had given its substance without the name in certain propositions of Book I. Evidently influenced by his dynamical interests, Newton regarded all variables as functions of time and all variation as primarily happening as time flows on. He, therefore, invented a calculus to determine the rate of change of any magnitude regarded as a function of time. These rates were called fluxions. They were with respect to time. The rate of change of a magnitude x with respect to another magnitude y he defined as the ratio of the fluxion of x to the fluxion of y. In spite of Newton's fluxional approach providing the beginner with an intuitive and familiar illustration of the concepts of calculus and in spite of time having been appropriately basic in the specific problem that led Newton to its discovery, it was soon felt that it was needless to drag in time where it was not concerned; and Leibnitz produced a calculus unobsessed by the spirit of time. But insularity kept out for long the more fertile calculus of Leibnitz from the home of Newton. It was not till 1812 that the sterile calculus of fluxions was deposited in the museum. In that year the Analytical Society of Cambridge was founded to adopt Leibnitz in place of Newton; or as Babbage, one of its founders, put it, "To promote the principles of pure *D*-ism in opposition to the *Dot*-age of the University". Non-mathematical readers can see the pun if they are told that the notation for the differential coefficient of x was $\dot{x}$ (x dot) in Newtonian calculus and Dx (Dee x) in Leibnitzian calculus.

Newton's Approach

Thus Newton's approach to mathematics was from the side of physics and the phenomena of the material universe and for the purpose of employing it as a tool. Concrete phenomena are ever so complex and there is no end to the variety of tools which they call for. Even to-day mathematics is being enriched by new tools demanded by newly discovered phenomena in physics; witness the calculus of operations, the calculus of tensors and the theory of Wave Function. Green, Kelvin and Poincare are some of the later mathematicians who enriched mathematics in this way. The Indian mathematicians of the Vedic age had enriched geometry similarly, *i.e.*, by the urge to solve a concrete problem.

Ramanujan's Approach

But Ramanujan's approach to mathematics was from another side, the side of form—its beauty and potency. Euler, Galois and Riemann had done so before. The Greek mathematicians of the classic age had enriched geometry similarly. We saw that Newton's boyhood-experience registered with his mode of approach to Mathematics. It was so with Ramanujan too. His boyhood was spent in making patterns of magic squares, playing with the formulæ enumerated in Carr's *Synopsis* and listening to *puranic* discourses on the infinite attributes of God. Two intimate friends who were with him virtually all through, except during his sojourn in England, assure me that his sensitiveness to form was unusual and that, as they could not follow mathematics, he used to entertain them till late in the night with interpretations of the *Ramayana* and the *Mahabharata* based on certain patterns of thought which were exquisitely beautiful and the mathematical correlates of which he would occasionally indulge in expounding.

Force of Form

Hardy's reminiscence about the taxi-cab No. 1729 is significant. Hardy's remark that it was 'dull' elicited a prompt reply from Ramanujan: "No, it is a very interesting number; it is the smallest number expressible as a sum of two cubes in two ways." Hardy asked for the corresponding number for fourth powers and Ramanujan replied, after a moment's thought, that the first such number must be very large. The fascination and force of form may be traced behind most of Ramanujan's work on the theory of numbers and of modular functions. We witnessed a pretty manifestation of the same in a mathematical social evening at Madras in 1914 in which Ramanujan pierced, as it were, through the traditional integer-garb of the Leibnitzian form for the differential coefficient of the nth order and utilising the Eulerian generalisation of the factorial into the gamma function entertained the audience with the beauty of fractional differentiation.

Complementary Approaches

Both the approaches are necessary to disclose the potency of mathematics. But the illumination from Ramanujan's side of approach is more subtle and visible only to a select few; while that from Newton's side is more extensive and lights up many a path in many a field of knowledge.

CENTENARIES

An account of Sir Isaac Newton is given elsewhere in this issue.

Scheele, Carl Wilhelm (1742-1786)

CARL WILHELM SCHEELE, a Swedish chemist, was born at Stralaund, 19 December 1742. He was sent to college, but showing no talent for languages, was pronounced a dunce and was apprenticed to an apothecary. Here he studied the then known works in chemistry in spare moments and experimented secretly in the night-time. He served successively in some of the private pharmacies at Malmo, Stockholm, and Upsala. His employer at the latter place was curious to know why saltpetre, after being heated to a certain temperature and allowed to cool, gives off red fumes on being mixed with vinegar and asked a student studying chemistry about it; but he could not explain nor could Bergmann his professor. But later, Scheele told his employer that it was due to two acids. nitrous and nitric being there, the latter of which was expelled in the form of red fumes. This incident secured for Scheele the friendship of the professor and through it the patronage of the court and the public.

Scheele's record as a discoverer is probably unequalled, in spite of his poverty and poor laboratory facilities. He discovered the tartaric, fluosilicic, arsenic, uric, lactic, oxalic, gallic and several other acids. He discovered chlorine. He was the first to distinguish silica from alumina. He ascertained the nature of graphite. He found the composition of prussic acid and obtained glycerine. His only book *Aire and fire* recorded the observation made in 1773 that the atmosphere is composed of two gases—oxygen and nitrogen. As the book was published only in 1777, the priority of discovery went to Priestly, who announced his discovery earlier in 1774.

Scheele received from many quarters evidence of the high esteem in which he was held. He was offered professorships in several countries. But he preferred to work in his own private laboratory. When he got one, "Oh, how happy I am!", he wrote to a friend, "No care for eating or drinking or dwelling, no care for my pharmaceutical business, for this is mere play to me. But to watch new phenomena this is all my care, and glad is the enquirer whose discovery rewards his diligence; then his heart rejoices." His discovery of the means of producing Prussian Blue immortalised his name in the words "Scheele's green".

Scheele died 26 May 1786.

S. R. RANGANATHAN.

University Library,
Madras.

"Nature and nature's laws lay hid in the night
God said, 'Let Newton be' and all was light."

ALEXANDER POPE.

"It did not last; the Devil howling 'Ho
Let Einstein be' and restored the *status quo*."

J. C. SQUIRE.

SCIENCE NOTES AND NEWS

Electrical Properties of Beidellite Membranes.—Investigations on the electrochemical properties of clay membranes by Marshall and Krinbill (*J. Amer. Chem. Soc.*, 1942, 64, 1814) have resulted in the preparation of an improved type of clay membrane (Beidellite membrane) which has got several advantages over the Montmorillonite membrane which was being used on previous occasions. The beidellite membranes attain equilibrium with fresh solutions much more quickly, the initial asymmetry potentials disappear more rapidly on soaking and the individual differences between membranes are very much smaller. Added to this the new membrane can be used in the potentiometric estimations of both mono and bivalent cations while the montmorillonite membrane can be used only in the estimation of monovalent ions. The effect of temperature of baking on the nature of the membrane is also investigated, using different sodium salts. When the beidellite membranes are employed in the potentiometric determination of sodium in different sodium salts, excellent reproducibility is noticed. The potentials obtained with solutions less concentrated than 0·03 N are within 1 millivolt of those calculated using the Nernst equation. Sodium chloride, sulphate and ferrocyanide give practically the theoretical potentials while the citrate gives low values probably due to complex formation. The experimental determination of the mobility of different cations within the clay membranes can enable one to predict the theoretical potentials for mixtures of cations. M. R. A.

Nutritive Value of Yeast Protein.—Most of the protein requirement of man is obtained through cereals. But the proteins of the cereals, as a class are not nutritionally of the highest quality, since many do not contain a sufficient proportion of certain of the dietetically essential animo-acids. For a healthy diet, the ordinary cereal diet should be supplemented by other protein-containing foodstuffs. T. F. Macrae, M. M. El-Sadr and K. C. Sellers have published (*Bio. J.*, 1942, 36, 460) some very

interesting results on the value of yeast proteins as a supplement to a maize diet. Pigs do not thrive either on mere maize diet or even when supplemented with lysine or tryptophane, unlike the case of rats. Since the vitaminic extracts of yeast could not supplement the maize diet, the inadequacy of the maize proteins is obvious. The addition of 5 per cent. yeast (2·5 per cent. crude protein) to the maize diet change it from one unsuited for the rearing of pigs to one which yields fine animals. Yeast protein is not inferior to casein for this purpose. It is suggested that since high quality proteins and vitamins of the B-complex are the principal nutrient factors lacking in many poor diets, yeast which contains about 50 per cent. of high quality proteins and quantities of B-complex vitamins unsurpassed by any natural product, would correct the deficiencies of such diets more effectively than other foodstuffs. V. S. G.

Inflation of Shellac Prices.—As there has been a tendency for marked increase in prices of shellac in these two years, the Indian Lac Research Institute, in a press note, has drawn attention to the need for keeping the prices of shellac at a moderate level so that it may not lose its export market in the long run by the development of cheaper synthetic resins abroad. The dealers in shellac are advised to maintain the price of T.N. shellac between Rs. 50 and Rs. 60 per maund to prevent such a catastrophe. If a boom in prices is necessitated by supplies falling short of demand, the Indian Lac Research Institute, it is stated, would assist in augmenting the yield by demonstration and advice regarding improved methods of cultivation. It is hoped that those interested in the lac industry would avail themselves of the help offered by the Lac Research Institute and see to it that the demand for shellac in the foreign market, which is its mainstay, is not jeopardised by an undue inflation in prices. A. V. S.

Flora of the Bailadila Range.—Since the publication of "A Sketch of the Flora of the Bailadila Range in Bastar State" (Mooney, H. F., *Indian Forest Records*, N.S., 3, No. 7, 1942), the concerned region has become a place of much interest, especially from the point of view of Plant Geography. Bailadila Range forms an isolated unit by itself topographically as well as floristically; it is situated midway between the vast forest regions of the Northern and Southern India, at the same time being separated from them by wide gaps devoid of any important hill ranges; it mingles in its floristic wealth a number of species that show a Northerly affinity of distribution, those that show an Easterly affinity, those with Southerly affinity and those with Westerly affinity. The ecological formation of plant-associations have been dealt with at considerable length. Finally the author postulates the different possible modes of the transmigration of the plants from the southern and northern forest belts to this particular Range. B. G. L. S.

Antagonism between Strains of Mosaic.—Cases of definite antagonism between different strains of the peach-mosaic virus have been recorded in Colarado, U.S.A. (Bodine, E. W., *Phytopathology*, 1942). Elberta peach, affected by the "slight strain" of the virus, when reinoculated with the "severe strain" showed only symptoms of the former. That the mosaic of the "severe strain" was introduced into the plant tissue was insured in the control inoculations. The buds of the reinoculated tree were removed and inserted to healthy trees. The healthy trees thus inoculated developed symptoms of only the "slight strain" and indicated the complete inhibition of the "severe strain". M. J. T.

Factors affecting the Longevity of Cotton Seeds.—How long and under what conditions can cotton seeds be kept in storage without detriment to the germinating capacity? This question interesting to the farmer and trader alike is answered in a series of studies which have been going on for over ten years and the results of which are now published (D. M. Simson, *Jour. of Agri. Res.*, 64, No. 7). The studies were made with the seeds of American Upland and Sea-Island varieties. The moisture content of the seed has been found to be the factor of the greatest importance. Seeds stored in ordinary gunny bags soon attain an equilibrium with the moisture content of the environment, approximately 11 per cent. In two years such seeds deteriorated rapidly and in three years were all dead. In contrast, sun-dried seeds with approximately 8 per cent. moisture when stored in ordinary containers retain their viability for quite seven years and a few of them were still able to germinate even after ten years. If the moisture content does not go above 8 per cent. seeds can be kept even in air-tight containers; aeration does not seem to be necessary. Temperature is the second important factor, and three levels were compared, *viz.*, 90°, 70° and 33°, with moisture levels varying from 7 to 14 per cent. With the higher moisture content storage at 90° killed all the seeds in 4 months, and after 36 months only those with 7 per cent. moisture were unimpaired. In contrast, at 33° even the seeds with 14 per cent. moisture retained their vitality for 36 months. The 70° storage was intermediate with respect to moisture tolerance. Analysis showed that the deterioration is accompanied by an increase in the percentage of free fatty acids in the oil. A. K. Y.

Department of Chemical Technology, Bombay.—According to the Annual Report for 1941-42, the Department has been enriched by an endowment of Rs. 2 lakhs from the Sir Dorabji Tata Trust for the creation of a Readership to be named after Sir Dorabji Tata for the Pharmaceutical and Fine Chemicals Section. It is probable that admission to this course will be made in June 1943. It is satisfactory to note that the research activities of the Department have continued to expand and several new schemes have been undertaken on behalf of industry and subsidised by industrialists, industrial organisations, and

Government Departments. Particular attention may be drawn to the important series of investigations on chemicals and dyes needed in textile processing. It is interesting to note also that during the year, owing to the shortage or non-availability of standard proprietary products due to the war, numerous substitutes offered in their place were received for tests and that several of the wetting agents, desizing agents, textile antiseptics and mildewed fabrics were tested by methods evolved or standardised by the research workers of the Department.

Administration Report of the Government Mineralogist for 1941, Ceylon, Part II—Revenue (1).—This report which covers ten pages, describes the nature of the routine activities as well as of the special studies during the period. Regular geological survey work has provided additional information on the geological history of the island.

Two investigations of economic importance deserve special mention. These relate to the utilisation of (1) a fairly large peat deposit and (2) the vanadium content of ilmenite segregation bodies occurring in some parts of the island.

K. R. K.

Illustrating the Technical Lecture.—According to H. E. Dance (*Engineering*, July 3, 1942, page 15), good lantern slides can be made from typescript, if the imprint has been made with ordinary thin black carbon paper, instead of a ribbon. Notes and sketches can also be typed directly on cellophane, by placing the cellophane in a folded carbon paper so that the working surface of the carbon is applied to both faces of the cellophane. The matter is then typed without using the carbon. Cellophane slides need not be bound. The lettering does not rub off, and they are much more convenient to store when they are without glass covers. For projection they may be placed between two cover-glasses which have a tape or paper hinge down one edge, forming a temporary slide from which the cellophane slip is removed as soon as projection is finished. Half-a-dozen of such open "glass sandwiches" will meet the needs of most lectures. On page 54 (July 17, 1942) of same Journal, R. Fairthorne points out that cellophane can be sensitised with blue print solutions in much the same way as paper, and will give good results with half-tone negatives as well as line. For slides of more pleasing colour and greater permanence, any of the "ferri-to-ferro" processes can be used.

Timber for Aircraft.—Wood of the aircraft quality needs to have a high strength to weight ratio. The proper selection, conversion and seasoning of the timber is a matter of high technique. Experiments have proved the suitability of Himalayan fir and spruce and operations for extracting these woods on a commercial scale have already started. Possibilities of extracting champ and bonsum from the Assam woods are now under investigation. The Kulu Division in the Punjab, the Teri-Garhwal State and the forests of Assam are three locations from where it is expected to obtain these special quality woods. In regard to various other supplies for Defence purposes, the timber resources of India last year met demands through the Department of Supply to the total of 396,000 tons and demands placed on the Department in the current year are expected to reach a total of over one million tons. India's sawmill equipment will be enriched by additional machinery which she will receive under Lease-Lend from America.

Industrial Research Institute.—According to *Science* (1942, 95, 571), the Industrial Research Institute, which is an affiliate of the National Research Council, undertakes to promote improvement of methods and more economical and effective management of industrial research through the co-operative efforts of its members. The membership is composed of 45 industrial concerns maintaining research laboratories. Their chief executives in charge of research represent them in the activities of the Institute which has its headquarters in Chicago.

At the fourth annual meeting held at Cleveland on May 22 and 23, round-table discussions were held which dealt chiefly with the adjustment of research programmes and personnel to meet war conditions.

According to *Nature* (September 19, 1942) among a number of Soviet scientific films exhibited at the Imperial Institute Cinema, London, on September 12, the one on "Experiments on the Revival of Organisms" was undoubtedly the most impressive. After a brief and exceptionally clear pictorial explanation of the function of the heart and lungs the film lead up from the artificial setting in motion of an individual organ, the heart, to the revival of a dog's severed head and finally to the revival of animal itself, from which the blood had been completely drained off and the heart-beats and respiration of which had ceased for ten minutes. The blood was recirculated by means of an artificial circulatory system, the "autojector", the deceased animal heaved its first sigh, heart-beat and respiration began to register, and, after a short time, the autojector was disconnected and life proceeded. Within a few days the dog was its normal self again and, as the film showed, "lived happily ever after". The producers are to be congratulated on the skill and beauty of this film, which, while maintaining full scientific clarity throughout, nowhere offended the æsthetic senses, opened up an unlimited perspective of scientific advance and could not fail to instil into the most unimaginative minds a profound respect for scientific effort and achievement. The commentary to the films was prepared by Prof. J. B. S. Haldane.

Wartime Sources of Vegetable Rubber in India.—In the Indian Forest Leaflet No. 22 (Silviculture), Mr. T. V. Dent considers the formation of emergency plantations for war-time supplies as useless, since no plantation will yield an appreciable return of harvested rubber in less than four years from its establishment. Under conditions of forced cultivation only the para (*Hevea braziliensis*,

Euphrobiaceæ) or Ceara (*Manihot glaziovii* Euphorbiaceæ) might be able to give a worth-while return in about four years.

Attention can, therefore, be paid to wild rubber-yielding plants. About 17 of them are reviewed and it is surmised that, if the collection is subsidised, wild *Ficus elastica* from Assam, Bengal, Sikkim and Bhuthan may yield several hundred tons of raw rubber annually.

In addition to the immediate application of intensive methods of management to existing rubber plantations in South India, re-exploitation of the existing old and abandoned plantations of *Ficus elastica* from Assam and Bengal alone, may be expected to contribute addditional 30 to 40 tons annually.

Detection of Cracks in Engineering Materials.—Fluorescent light has been effectively pressed into service for the detection of flaws or cracks in engineering materials by The Colloidal Research Laboratories, London, in their "Glo-Crack" system. The articles to be examined are first immersed for a short period in a hot bath of fluorescent material. They are then transferred to a second bath containing a solution which removes all the fluorescent material except that which is entrapped in any flaws or cracks. After this, each article is examined under ultra-violet light and every small flaw or crack glows with the characteristic colour while the remainder of the specimen remains dark. In this way a crack, no matter how fine, can scarcely escape detection, and this is attained without severe eye-strain or mental fatigue on the operator. Other advantages are its applicability, without staining or the necessity for after-treatment, to all metals and to many other materials, its simplicity and cheapness of operation, and the quickness with which the process can be carried out, even on mass-produced articles (*Nature*, September 19, 1942, p. 343).

Industrial Research Fund.—The Government of India have decided that a Fund, *viz.*, Indian Research Fund, should be constituted by grants from the Central Revenue to which additions are to be made from time to time from other sources. A provision has been made in the Central Budget for an annual grant of 10 lakhs of rupees to this fund for a period of 5 years and, the other sources will comprise grants, if any, by Provincial Governments, by industrialists for special or general purposes, contributions from Universities and Local bodies, donations, benefactions, royalties, etc. The Council of Scientific and Industrial Research which has now been established on a permanent basis, with the Member of the Council of His Excellency the Governor-General in charge of the portfolio of Commerce as *ex-officio* President, will exercise full powers in regard to expenditures towards (*a*) the promotion, guidance and co-ordination of scientific and industrial research in India including the institution and the financing of specific researches; (*b*) the establishment or development and assistance to special institutions or departments of existing institutions for scientific study of problems affecting particular industries and trade; (*c*) the establishment and award of research studentships and fellowships; (*d*) the utilisation of the results of the researches conducted under the auspices of the Council towards the development of industries in the country and the payment of a share of royalties arising out of the development of the results of researches to those who are considered as having contributed towards the pursuit of such researches; (*e*) the establishment, maintenance and management of laboratories, workshops, institutes, and organisations to further scientific and industrial research and to utilize and exploit for purposes of experiment or otherwise any discovery or invention likely to be of use to Indian industries; (*f*) the collection and dissemination of information in regard not only to research but to industrial matters generally; and (*g*) publication of scientific papers and a Journal of industrial research and development. The Council will co-ordinate and generally exercise administrative control over the work of the Board of Scientific and Industrial Research and Industrial Research Utilisation Committee.

The Application of Nitrogenous Manures to Cotton.—Remarkably high yields of cotton have been reported as the result of applying sulphate of ammonia as manure for the cotton crop according to a special method (R. J. Kalamkar in *Nagpur Agr. Coll. Mag.*, 16, No. 4). The method consists in coating the cotton seed prior to sowing with dry sulphate of ammonia powder, the seed itself being moist with the wet paste of earth and cowdung which is usually rubbed over it to paste down the fuzz and make the seed run freely through the drill. This method was compared with (1) applying the same dose of sulphate of ammonia as a top-dressing three weeks after sowing and (2) applying one half the dose by drilling it with the seed at sowing time and the other half as a top-dressing three weeks after sowing and (3) control. The seed rate per acre was 20 lb. and the sulphate of ammonia used was at the rate of 10 lb. of nitrogen or the equivalent 50 lb. of ammonium sulphate per acre. The trials were conducted at the Government Seed and Demonstration Farm at Khandwa and the variety of cotton was V. 434. The experimental plots were laid out in a randomised block with five replications. The results show that a very high and significant increase in yield was obtained by the method of coating the seed with the fertiliser and that this increase in yield amounted to 66 per cent. over the control. The other two methods also gave increased yields of 14 to 18 per cent., but these increases were not statistically significant.

A. K. Y.

Suitability of Indian Woods for Battery Separators.—The essential characteristics of a wood for battery separators are good permeability, freedom for volatile acids, a low percentage of resinous matter, sufficient mechanical strength, good machining qualities, and resistance to the action of the electrolyte. The quantity of tannins and other colouring matter should also be reasonably small, so that they can be removed by a short-period chemical

treatment. The finished separator should be straight-grained and free of seasoning defects such as cracks and shakes. The Forest Research Institute, Dehra Dun, as a result of the detailed investigation into the matter, considered the following woods as possibilities for the purpose of manufacturing battery separators from the standpoint of their anatomical structure and physical properties: (1) *Adina cordifolia* (haldu), (2) *Cupressus torulosa* (cypress), (3) *Michelia champaca* (champak) and (4) *Talauma phellocarpa.*

The timber is converted into planks, which are air-seasoned before manufacture into battery separators. The separators, after manufacture, are given a chemical treatment to remove all the volatile acids, and to get rid of tannins and resinous matter. (See also the Indian Forest Leaflet No. 14, 1942. Price As. 4 or 6*d*.)

The results so far obtained show that there is practically no difference in the behaviour of cells fitted with the above Indian woods and Port Orford cedar (*Chamœcyparis lawsoniana*), an American wood, which till recently was the most commonly used wood for this purpose.

The Ripening Coconut.—Studies on the growth of the ripening coconut and principally with reference to the changes undergone by the fibre throw interesting light on the formation and the progressive changes in composition of the other important and really the main coconut product, the kernal itself (S. R. K. Menon, *Ind. Jour. of Agr. Sci.*, 12, Part III). The method of study consisted in selecting one particular bunch on a tree and following the changes from the very infancy of the fruit to its ripe stage, three such trees being selected for the purpose of confirmatory results. The results confirm the correctness and the wisdom of the present practice of gathering only coconuts which are not fully ripe when fibre production is an important objective. Where oil is the important consideration the nuts have to be gathered at a much later stage, so that the interests of the oil and coir industries are opposed to each other. Taking the particular points studied, it is seen that as regards the volume of the fruit and the weight, the increases are equal during the first six months and then the rate for the volume becomes slow and later begins to diminish. On the other hand, weight begins to drop sharply after the same period until it is only one half of the maximum reached. The water in the nut increases rapidly and reaches a maximum in about three months, after which it declines steadily and sharply until it is only about a seventh part of the maximum, in the tenth month. As regards the kernal it begins to form only after the first three or four months but once begun the growth is very quick, reaching a maximum in the ninth or tenth month, after which the change consists only in an increase of density, when the formation of fat becomes vigorous. Ultimately the moisture content falls and the gross weight also registers a decline; the fat content is said to go on increasing to the last days of the growth of the fruit. The fibre as it matures increases in lignin and loses both colour and gloss practically until the very last stages of growth; the non-lignin content increased up to the sixth month steadily, but became more or less stationary thereafter. The picking of the nut when not fully ripe therefore results in a fibre of high non-lignin content and a low-lignin content.

A. K. Y.

Wood Disc Dowel Joints in Timber Framed Structures.—In framed structures, properly designed joints are just as important as properly designed members, because the transmission of stress from one member to another depends upon the efficiency of the joints. In timber structures, it is difficult to make a satisfactory joint with bolts and rivets. A great variety of joint details are, therefore, in use. These usually require too much steel and labour, and are very costly.

The wood disc dowel joint requires very little steel; it is simple to make; it is very efficient and allows the use of planks instead of thick solid scantlings. A disc dowel is a circular wood disc, generally tapered each way from the middle so as to form a double conical frustrum. It is fitted into prebored holes half in one member, and half in the other. A bolt is used through the centre of the disc to keep the jointed wood members from spreading apart. The dowel can be made of any hard wood that seasons easily and keeps its shape well. *Babul, sissoo* and rosewood are suitable for making disc dowels. Other hard species can also be used, but many hard woods are difficult to season and liable to warp and split. Structural joints in timber frames, if made with wood disc dowels, reduce the cost of timber structures very substantially as has already been demonstrated. V. D. Limaye's leaflet on Wood Disc Dowel Joints in Timber Framed Structures (*Indian Forest Leaflet* No. 31), explains the function of the disc dowel, and shows how to make these typical structural joints in timber.

Post-War Indian Trade.—Addressing the All-India Manufacturers' Organisation in Bombay, Sir M. Visvesvaraya stressed the need to safeguard Indian trade and Indian interests in the post-war period. Proceeding he said that as soon as the war was over, India might again be exposed to the fury of an international economic war. To give the country adequate protection, it was necessary to appoint at once a representative central council of business men, experts and leaders in science and politics, to watch the trends and make preparations to meet all possible obstacles and opposition. It might be called a Development Board or an Economic Council, and might take the place of the Consultative Committee of Economists on Post-War Reconstruction, appointed by the former Commerce Member.

Explaining the objects of the Manufacturers' Organisation, the steps taken by the various belligerent countries in regard to post-war reconstruction, and conditions in India, Sir M. Visvesvaraya stated that there were now a number of Indians on Viceroy's Executive Council. Post-war reconstruction and industries were each of them important enough to require the whole-time services of a Member to itself. Nevertheless, both of them were left

with the Commerce Member, whose time was fully taken up with matters connected with the war emergency.

"The people are now faced", he said, "with a great struggle immediately the war ends, to render secure the future food supply and income of the nation. They can neglect this duty only at their peril. It has been said there will be war after war; economic war may follow military war, and expose the industries and trade of this country to severe international competition."

Referring to India's industrial development, he said that the developments recorded in Canada and Australia showed that this country had missed a great opportunity to build up its industries in the present war. "This was", he continued, "through lack of any policy in the Government of the country and lack of co-operation and interest on its part to benefit the Indian population".

National Institute of Sciences of India.—At a meeting of the Council's Committee of the National Institute of Sciences of India, held on the 11th December 1942, the following were duly elected as Ordinary Fellows of the Institute:—

Dr. J. C. Bardhan, D.SC., Calcutta; Mr. R. C. Bose, M.A., Calcutta; Dr. N. C. Chatterjee, D.SC., Dehra Dun; Mr. M. N. De, M.B., M.R.C.P., Calcutta; Dr. R. D. Desai, D.SC., D.I.C., Bombay; Dr. B. N. Ghosh, D.SC., Calcutta; Dr. C. S. Pichamuthu, Ph.D., Mysore; Mr. K. Ramiah, M.B.E., M.SC., Dip.Agr., Indore; Prof. T. R. Seshadri, Ph.D., Guntur; Dr. S. C. Sirkar, D.SC., Calcutta; Mr. V. V. Sohoni, M.SC., New Delhi; Dr. N. R. Tawde, M.SC., Ph.D., Bombay; Mr. E. T. Vachell, M.A., F.G.S., Digboi.

Nagpur University.—Dr. A. Nagaraja Rao, Professor of Applied Chemistry and Chemical Engineering in the Lakshminarayan Institute of Technology, has been appointed Chief Chemist, Tata Chemicals, Mithapur. In the vacancy caused by the resignation of Dr. Nagaraja Rao, Dr. P. S. Mene, M.SC., Ph.D. (Lond.), of the C.P. Educational Service, has been appointed Reader in Applied Chemistry and Chemical Engineering.

MAGNETIC NOTES

Magnetic conditions during November 1942 were less disturbed than in the previous month. There were 17 *quiet* days and 13 days of *slight* disturbance as against 13 quiet days, 13 days of slight disturbance and 4 of moderate disturbance during the same month last year.

The quietest day during November 1942 was the 6th, while 24th was the day of the largest disturbance.

The individual days were classified as shown below:—

Quiet days	Disturbed days		
	Slight	Moderate	Great
3–7, 9, 11, 12, 14–19, 21, 22 30	1, 2, 8, 10, 13, 20, 23–29	Nil	Nil

There were no magnetic storms during the month of November 1942 while one moderate disturbance was recorded during November 1941.

The mean character figure for the month of November 1942 was 0·43 as against 0·70 for the same month last year.

A. S. CHAUBAL.

SEISMOLOGICAL NOTES

During the month of November 1942, seven slight, two moderate and one great earthquake shocks were recorded by the Colaba seismographs as against six slight, four moderate and three great ones during the same month in 1941. Details for November 1942 are given in the following table:—

Date	Intensity of shock	Time of origin I. S. T.	Epicentral distance from Bombay	Co-ordinate of the epicentres (tentative)	Depth of focus (tentative)	Remarks
		H. M.	(Miles)		(Miles)	
7	Slight	14 02	3890	..	60	..
10	Great	18 11	5430	Lat. 48°S., Long. 27° E. near Marion Island.	..	..
15	Moderate	23 42	4250	..		..
17	Slight	03 56	1360	..	190	Epicentral region. In the Hindu Kush mountains. Reported felt at Peshawar and Lahore.
18	Slight	18 31	2?30	..	..	..
20	Slight	10 48	1210	..	..	..
21	Slight	20 32	2720	..	..	..
25	Slight	09 26	1810	..	..	..
26	Slight	20 58	4530	..	..	Epicentral region. Off the west coast of Norway. Reported felt at Bergen and Sand (near Stavangar).
28	Moderate	17 09	7150	..	..	..

ANNOUNCEMENTS

Current Science and H. H. the Maharaja of Mysore

Readers of *Current Science* will be interested to learn that on the occasion of his recent visit to the Indian Institute of Science, on Tuesday, the 15th December 1942, His Highness the Maharaja of Mysore was graciously pleased to accept a few numbers of the current volume of the Journal, placed in a case bound in morocco leather, whch was inscribed as follows:

> *Respectfully submitted to His Highness the Maharaja of Mysore, by Prof. J. C. Ghosh, President, The Current Science Association, Bangalore.*

Annamalai University—*Endowment by H. H. the Maharaja of Travancore.*—On the occasion of the Twelfth Convocation of the Annamalai University, held on the 9th December 1942, the Vice-Chancellor announced that H.H. the Maharaja of Travancore who was invited to address the graduates of the year, had endowed one lakh of rupees to the University. The purpose of the endowment will be revealed later.

Indian Statistical Conference.—The sixth session of the Indian Statistical Conference, 1943, originally intended to be held in Lucknow in January 1943, will not take place in Lucknow. In order however to avoid a break in the continuity of the Conference, the Council of the Indian Statistical Institute has decided that a short session should be held in Calcutta and arrangements are being made accordingly. It is expected that the Conference would be opened on or about the 2nd January 1943. The exact date and detailed programme would be circulated as soon as possible.

Blood Banks—Errata.—We wish to invite the special attention of our readers to the *Errata* pertaining to the article on Blood Banks, published elsewhere in this issue.

According to *Nature* (October 10, 1942), Sir Henry Dale, President of the Royal Society, has accepted the Directorship of the Laboratories of the Royal Institution, London, with the Fullerian Professorship, in succession to the late Sir William Bragg.

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 90, Nos. 4620 and 4621.

"Journal of Agricultural Research," Vol. 64, No. 11; Vol. 65, No. 2.

"Indian Journal of Agricultural Science," Vol. 12, Pt. 4.

"Agricultural Gazette of New South Wales," Vol. 53, Nos. 8 and 9.

"Biochemical Journal," Vol. 36, Nos. 5 and 6.

"Chemical Products," Vol. 5, Nos. 9-10.

"Experiment Station Record," Vol. 87, No. 1.

"Indian Forester," Vol. 68, No. 12.

"Transactions of the Faraday Society," Vol. 38, Pt. 9.

"Indian Farming," Vol. 3, Nos. 10 and 11.

"Horticultural Abstracts," Vol. 12, No. 3.

"The Bulletin of the Indian Central Jute Committee," Vol. 5, No. 8.

"The Review of Applied Mycology," Vol. 21, No. 8.

"Nature," Vol. 150, Nos. 3801-3802.

"Journal of the Bombay Natural History Society," Vol. 43, No. 3.

"Canadian Journal of Research," Vol. 20, No. 8.

"Science and Culture," Vol. 8, No. 6.

"Journal of the Scientific and Industrial Research," Vol. 1, No. 1.

"Indian Trade Journal," Vol. 147, Nos. 1898-1903.

Books

Annual Review of Biochemistry, Vol. 11. Edited by James Murrey Luck. (Annual Reviews Inc., California), 1942. Pp. x + 736. Price $5.00.

Hydrogen Ions, Vol. I. Third Edition. (Edited by E. H. Tripp). By Hubert T. S. Britton. (Chapman and Hall, London), 1942. Pp. xx + 420. Price 36*sh*.

Hydrogen Ions, Vol. II. Third Edition. (Edited by E. H. Tripp). By Hubert T. S. Britton. (Chapman and Hall, London), 1942. Pp. xx + 443. Price 36*sh*.

Yantric Sodhanchya Naveenya Katha (in Marathi). By Kasinath Anantha Damle. (The Author, Kalabhavan, Baroda), 1940. Pp. 140. Price Rs. 1-8-0.

Modern Pottery Manufacture. By H. N. Bose. (Ceramic Publishing House, Bhagalpore), 1942. Pp. vi + 481. Price Rs. 6-8-0.

ERRATA

Vol. 11, *No.* 11, *November* 1942

Page 423, para 3, line 8, *for* "useful References", *read* "Useful References". Para 5, line 14, *for* "Universal", *read* "universal". Para 6, line 4, *for* "semisolid", *read* "semi-solid". Para 8, line 2, *for* "Air Raids", *read* "air raids".

Page 424, para 1, line 3; *for* "into recipient", *read* "into a recipient"; line 8, *for* "nitrate", *read* "chloride". Para 9, *for* "*fluid must*", *read* "fluid must" (no italics). In the table, column 2, bottom, for "(= nothing small letter)", *read* "(= nothing, small letter)".

Page 425, in the List of Useful References, items (13) and (14), *delete* "(in press)", and *add* "1941".

Page 430, second column, line 1, *for* $K = (4 \cdot 68 \pm 5)$ *read* $K = 4 \cdot 68 \pm 0 \cdot 5$.

Page 438, second column, regarding magnification of the photomicrographs, *for* $\times 60$ *read* $\times 60$, reduced to ½.

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